BRITAIN'S LEADING AIR POLLUTION JOURNAL

CLEAN AIR

SPRING 1975

VOL. 5 NO. 17

PRINCIPAL CONTENTS

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Clean Air Over London
Lord Ashby, FRS

The Determination of SO_2 in the Ambient Atmosphere. A Survey of Some Interference Effects
G. B. Marshall

Air Pollution in Europe and the Fuel Shortage
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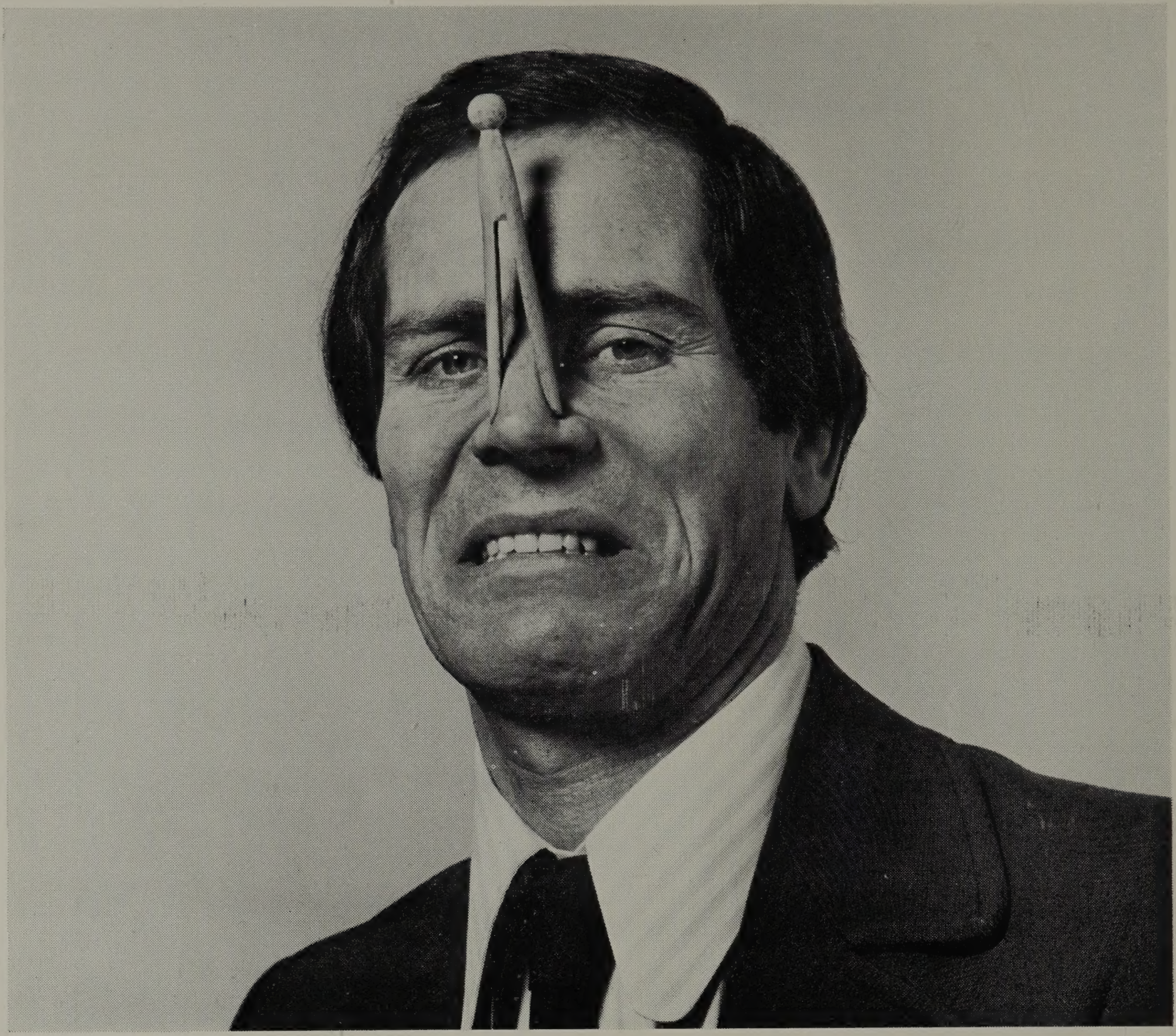

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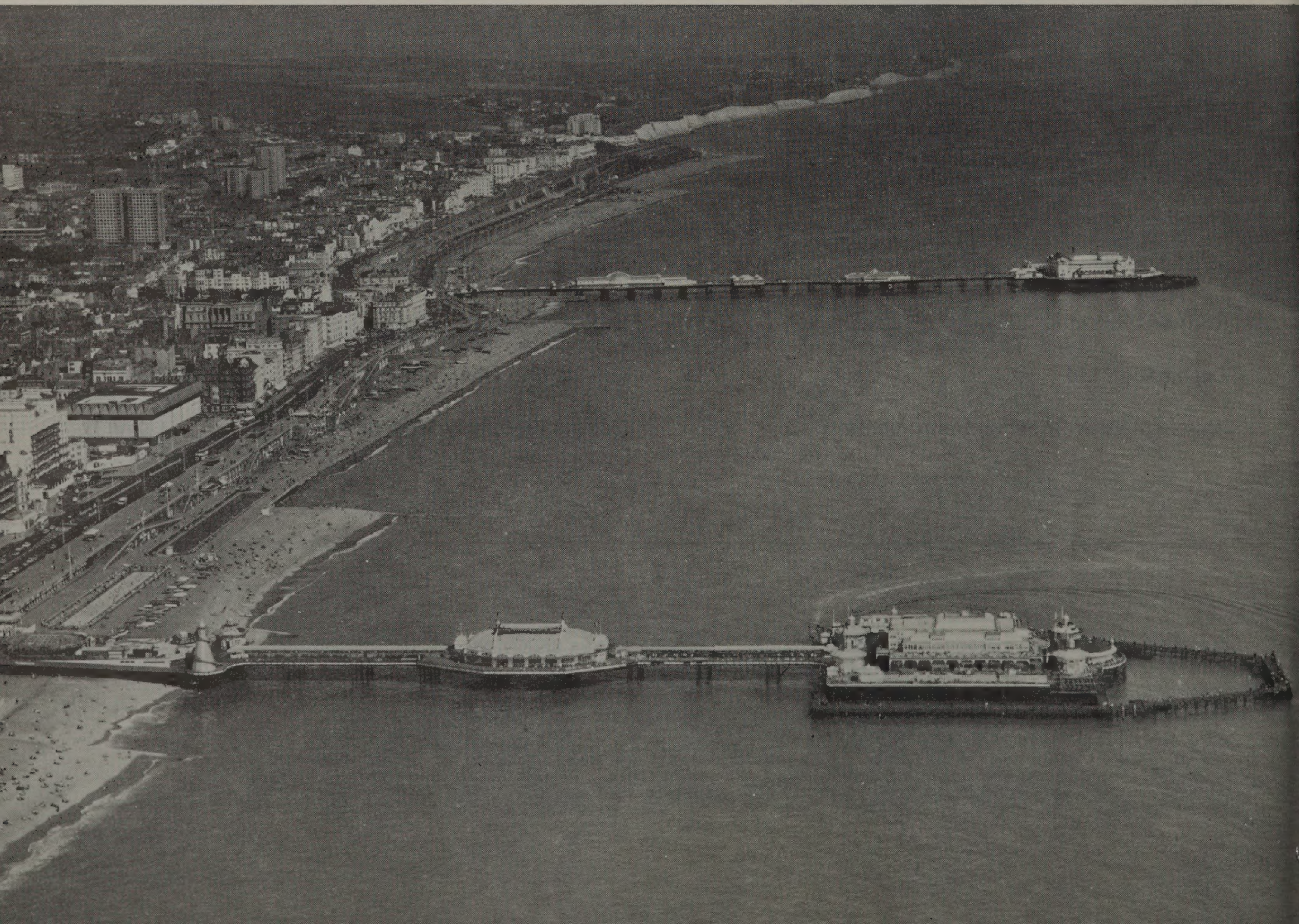

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CLEAN AIR

The Economic Factor

The economic factor, whether we like it or not, is always with us, and it can be applied in different ways to suit the philosophy of the person applying it. At one end of the scale is the dedicated environmentalist who would argue that on no account should such a factor ever be allowed to enter into calculations concerned with the control of any form of pollution. No matter what the cost, the proper controls should always be implemented—even if this results in the complete closure of a particular plant or factory. Such an extreme view does not, of course, take into account the consequent unemployment. At the other end of the scale is the industrialist who is more concerned with the production and marketing of his product than with the installation of proper control equipment because the additional costs incurred might well increase his price beyond market acceptability. Between these two extremes are a whole host of people whose views tend to follow more the middle of the road; that is to say, they take up the position that the economic factor must be given due, but not undue, consideration.

Other factors, however, do come into this argument. The main one that must be considered is the effect of pollution on the health and well being of the people. The other one is the effect of pollution on amenity. This Society embraces a very large spectrum of membership and although it may be fairly said that we do not have any members who represent the absolute extremes described above, we do have some members who tend towards either one side or the other. Whether or not the Society as such has a definite and specific policy on this matter is very hard to say but, it could probably be summed up in the statement that the economic factor should not be considered where human health and welfare are at stake but that proper consideration should be given to the economic factor where the effect is on amenity only.

Now the Government is applying the economic factor with a vengeance. In July, 1974 the Control of Pollution Act received the Royal Assent and was put on the Statute Book. This was the first Statute addressed solely and specifically to various forms of pollution. It reflected the increased concern and interest shown for the subject by all sections of the community including the Government and scientific agencies at all levels. The Act seeks to minimise pollution of land by waste products; it extends the existing law on water pollution to virtually all inland and coastal waters; it provides far more control of noise; and it augments the law relating to air pollution. Its provisions impose new duties and responsibilities on county councils, district councils and water authorities; and it alters the role that these authorities have previously assumed. Inevitably, these changes in the law and the administrative arrangements for its enforcement will have a significant impact on those in trade, commerce and industry who will be called upon to comply with the requirements of this Act. The architects of the Act believe that if all its objectives are realised, various forms of pollution will be reduced, and the environment will be afforded greater protection and the quality of life greatly enhanced. But, although the Royal Assent was given for this Act some seven months ago, only one small part has come into operation and that because of another Act, the Health and Safety at Work Act, which had a direct effect on the Alkali Inspectorate.

The reason that no further action has been taken is because of the economic crisis with which the country is faced and because there is no money available to implement the various parts of the Act which have been long awaited. In fact, instead of regulations bringing this new legislation into operation what has been issued is a Government circular telling local authorities to prune their spending and to consider very carefully before introducing anything new. No further growth in smoke control is suggested at a time when, generally throughout the country, local authorities are realising how valuable this is, not only to the improvement of amenity but, more important, to a definite improvement in people's health. So here the economic factor is being applied in a way which could be detrimental to the health of the populace.

That this should happen at a time when public money is being spent on an advertising campaign on the saving of energy is Gilbertian if no worse. for one of the best methods of saving energy is by a proper smoke control programme throughout the country. True, smoke control costs something, but its cost is comparatively small compared with the savings in energy that could be made. In fact, the cost of the advertising programme to save energy could go far towards implementing smoke control in a considerable number of places where it is most required. Is it not time that authorities looked again at this question? What is the good of legislation on the Statute Book when it cannot be implemented? It simply then becomes bad law and bad law falls into disrepute. This hold-up in the pollution control programme could have further reaching consequences than at first realised. It has taken over twenty years from the time of the publication of the Beaver Report for us to reach our present standards. These have been twenty years of very hard work in which much has been achieved, but some of these achievements could now be undone by a short-sighted policy of petty economy. Let us hope that all local authorities concerned will appraise the economic factor properly and put it in its right perspective; and let us go ahead with the control of pollution in this country in a progressive manner.

INTERNATIONAL CLEAN AIR AND POLLUTION CONTROL CONFERENCE

incorporating the 42nd ANNUAL CLEAN AIR CONFERENCE

20th—24th OCTOBER 1975

THE DOME, BRIGHTON

OPENING SESSION – MONDAY, OCTOBER 20

Formal opening at 20.30. The President will present the annual address.

SESSION TWO – TUESDAY, OCTOBER 21

INTERNATIONAL ATTITUDES TO THE CONTROL OF POLLUTION

1 A COMPARISON OF APPROACHES.
2 THE UK APPROACH AND ITS IMPLICATIONS.
  (a) By Central Government.
  (b) By Local Government.
3 THE EEC PHILOSOPHY OF CONTROL.
4 THE EEC APPROACH TO MEDICAL STANDARDS.
5 A NEW APPROACH TO STANDARDS.

SESSION THREE – WEDNESDAY, OCTOBER 22

ENERGY FROM THE CONTINENTAL SHELF

6 GEOLOGY AND EXPLORATION.
7 PRODUCTION, AND CONTROL OF POLLUTION.
8 NORTH SEA OIL—IN CONTEXT AND PERSPECTIVE.

SESSION FOUR – THURSDAY, OCTOBER 23

TECHNICAL ASPECTS OF CONTROL OF INDUSTRIAL POLLUTION

9 GASEOUS EMISSIONS.
10 EFFLUENTS.
11 SOLID AND TOXIC WASTES.

CONSERVATION OF RESOURCES

12 HUMAN RESOURCES.
13 ENERGY AND RAW MATERIALS.

SESSION FIVE – FRIDAY, OCTOBER 24

POLLUTION FROM ROAD VEHICLES

14 THE EEC PHILOSOPHY OF CONTROL.
15 THE UK PHILOSOPHY OF THE CONTROL OF EMISSIONS AND NOISE.
16 THE TECHNICAL PROBLEMS OF CONTROL OF EMISSIONS AND NOISE.
CLOSING ADDRESS BY THE PRESIDENT.

Speakers will include among others, Professor C. E. Barthel of Miami University, Professor P. J. Lawther of the Medical Research Council, Professor F. Roberts of Brunel University, Dr. L. A. Clarenburg of SICOM (Netherlands), Dr. L. E. Reed of the Central Unit on Environmental Pollution, Mr. M. F. Tunnicliffe, HM Deputy Chief Alkali and Clean Air Inspector, Mr. T. H. Iddison of Dartford District Council, Mr. David Collins of Ricardos, Mr. H. B. Greenborough, the Chief Executive of Shell Mex and BP Ltd, Dr. Stuart Reed and Mr. R. A. Fish of the Scientific Branch of the Greater London Council, M. Detrie of CITEPA, France, Dr. Malz of Emschergenossenschaft, West Germany and Dr. P. Recht, Mr. D. Verdroni and Mr. S. Johnson of EEC.

AIR POLLUTION IN EUROPE AND THE FUEL SHORTAGE

by

J. H. Boddy, C. Eng., M.I.Mech.E., P. E. Bright, M.A., C.Eng., M.I.Mech.E.
G. S. Parkinson, B.Sc., A.R.I.C.

SYNOPSIS The paper briefly describes and contrasts the development of emission control regulations in Europe and the USA. It gives the cost of the severe standards proposed for gasoline engines in the USA and shows that in Europe significant reductions in CO and hydrocarbons have been achieved at minimal cost. It outlines the current and proposed European gasoline lead legislation and details the effect on energy availability and high cost these would incur, without producing any measurable benefit. It mentions alternative means of reducing lead emissions. Finally it stresses that air quality standards should be based on medical criteria although it appreciates Governments, who alone can make the ultimate decisions, must also take account of less rational factors.

1. Introduction

Measures to reduce and control vehicle emissions are of comparatively recent origin in Europe. A much more obvious and pressing need existed to reduce air pollution from smoke and dirt from industrial and domestic fuel combustion, mainly of coal. For example in the U.K. the Clean Air Acts of 1956 and 1968, together with certain voluntary measures to improve the efficient use of fuels have substantially reduced smoke and grit emissions to the benefit of both public health and amenity. As a result of the improved combustion there have also been significant savings of fuel. Smoke from badly operated or maintained diesels came under close scrutiny during this period and subsequently became subject to progressively more severe control. The Common Market countries have a directive 72/306 on smoke emissions and are expected to adopt ECE Regulation 24 which lays downs stringent emission requirements. The U.K. has a more severe control requiring that all new diesel engines are manufactured in accordance with BS AU 141a; 1971.

1.1

This specifies the standard conditions for test bed procedure and includes a 100hr. type test, output tolerances and exhaust gas opacity limits for production engines. It is easier to produce legislation than it is to administer it and from experience with the development of regulations for diesel smoke it has become clear that it is relatively easy to devise methods to control emissions for engines when new but difficult to ensure that these standards are maintained during use.

2. Gaseous Emissions

2.1

The need to control emissions from gasoline engines first arose in California in the early 1950s. The unique climatic and topographical situation of Los Angeles and its surroundings and the emissions from a large number of cars combined to help produce the notorious Los Angeles smog.

There are major differences between California and Europe which make the application of severe emission control in Europe both inappropriate and unnecessary. The conditions in Los Angeles are not reproduced anywhere in Europe, neither is there the same high car density. Gasoline is still relatively cheap in the U.S.A. where consumption per head is five times higher than in Europe; the State of California alone consumes more gasoline each year than Great Britain and Western Germany put together.

The legislative measures taken against gaseous emissions in Europe arise from a desire to control carbon monoxide levels in congested city centres. Hydrocarbon controls were added to avoid a situation in which carbon monoxide was limited at the expense of increasing hydrocarbons.

Far from saving fuel, these controls on gaseous emissions, if taken too far, can increase fuel consumption appreciably. In a future when oil supplies may not be able to meet normal demand such a policy calls for close cost-effective scrutiny.

TABLE 1

		EMISSION gm/MILE		
		H/C	*CO*	*NOx*
Pre-1966 (average values)	(1)	17	125	1500
1972 Federal Standard	(1)	3·4	39	Not limited
1973 Federal Standard	(1)	3·4	39	3·0
1974 California State Standard	(1)	3·2	39	2·0
1975 California State Standard	(2)	0·9	17·3	1·5
Federal interim standard for California 1975	(2)	0·9	9·0	2·0
Federal interim standard 1975 (all States except California)	(2)	1·5	15·0	3·1
Federal interim US standard for 1976	(2)	0·41	3·4	2·0
Federal US standard for 1976 delayed to 1977	(2)	0·41	3·4	0·4

Note (1) CVS Procedure according to Federal Register No. 10, 1970
(2) ,, ,, ,, ,, ,, ,, July 2, 1971

TABLE 2

Case	*Individual Car Costs*					*10 Year Totals US billions of $*			
	Emission hardware costs $/car	*Fuel economy change*	*MPG*	*Fuel consumption US gls/yr*	*Additional maintenance due to emissions, $/year*	*Hardware costs*	*Fuel costs*	*Maintenance*	*Total*
Case 1 Emission controls frozen at 1973 levels	$65	−10%	11·7	855	$3	6·5	17	1·5	25
Case 2 Proposed 1975 California Stds.	$225	−10%	11·7	855	$25	22·5	17	13	52·5
Case 3 1976 Federal Standards	$425	−20%	10·7	960	$58	42·5	37	29	108·5
Remarks	Based on average mileage of 10,000/yr, and 13MPG.					Based on 10 million new cars/yr.			

Cost of emission control in USA

2.2

Progressive stages of vehicle emission control taken to solve the Los Angeles problem are developing into a harmonised U.S.A. Standard for vehicles, aimed at achieving uniform air quality standards throughout the U.S.A. This may be a desirable move if free flow of traffic between the States is to take place and law enforcement in California made easier. However, the RECAT report to the U.S. Office of Science and Technology (1) recommends a two-car strategy, whereby cars of less severe emission control standards (ie 1972 Federal—see Table 1 below) might be used generally and cars with more severe restrictions confined to the sensitive areas. The report makes the further point that the severest standards recommended by the EPA cannot hope to achieve the targets for air quality in Los Angeles and other alternatives, such as restricting car usage or regulating the use to which land can be put, will also have to be considered.

Table 1 summarises the historical development of emission control standards in the U.S.A. It will be noted from Table 1 that the 1973 limits give a large improvement over those for 1966, which is achieved by various tuning devices, lowering of compression ratio, air injection into exhausts and exhaust gas recirculation. The cost, in 1973 prices, of these controls is approximately $65 per car. Whilst these controls add a substantial burden in the capital outlay on a car they are more significant in the fuel economy penalties they impose, adding approximately $34 to the annual fuel cost per car or, put another way, $25 U.S. billion over 10 years for U.S.A. as a whole. The largest part of the burden results from the introduction of devices necessary to reduce NOx emissions. The cost of emission controls so far proposed in the U.S.A. assume the continuation of the gasoline engine as a power unit for private cars. Alternatives have, of course, been considered but it is now well established that there are none which could be put into production in time to fulfil the targets laid down for emission control. The steps which have already been taken in the U.S.A. might not seem unreasonable in the light of the situation they have. However, the further reductions of NOx, hydrocarbons and CO required for 1975 onwards impose very much greater costs and will bring doubtful advantages. These costs are shown in Table 2 and include very large increases in fuel usage. The U.S.A. are thus involving themselves in very considerable costs for the benefit of reducing the number of incidents of smogs in the U.S.A., but probably not eliminating them entirely in Los Angeles. A country which is self-supporting in its oil supplies may feel justified in affording itself such luxuries, but as Europe is not in this happy state the luxury would become an extravagance, particularly as photochemical smogs are not a problem in Europe.

Europe

2.3

Although there have been occasional reports of incipient Los Angeles type smog in some European cities (3) (4) these occurrences are transitory and have been mainly attributable to sources other than vehicles. This does not mean to say that attempts should not be made to reduce exhaust emissions wherever possible. E.C.E. Directive is already in force in Europe and requires a 4·5 per cent maximum CO at idle, unburnt hydrocarbons from crankcase of 0·10 per cent max. of fuel burnt, and control of exhaust hydrocarbons and CO produced over the Standard E.C.E. test cycle according to the vehicle weight. For vehicles manufactured after October 1975, draft Directive 70/220 proposes a further reduction on these limits of 20 per cent CO and 15 per cent hydrocarbons during the test cycle. These significant reductions in vehicle emissions can be achieved by comparatively modest modifications to vehicle design and do not involve changes in fuel quality or recourse to catalytic devices. Nor do they generally result in any increase in fuel consumption, indeed their adoption may marginally improve it. There are at present no plans in Europe to control nitrogen oxides in exhaust emissions. A recent critical review of the available evidence showed, at least so far as the U.K. is concerned, that transport vehicles of all kinds contribute only about 25 per cent to the total nitrogen oxides produced from all fuel combustion.

3. Lead Legislation

If any one substance in gasoline has caused controversy in recent years, it is lead. Measures which may eventually bring about its elimination are being introduced into the U.S.A., but these were embarked on in order to provide unleaded fuel for vehicles fitted with catalytic after-burners. However, legislation and other moves against lead in Europe have been made on the grounds that the lead content of gasoline is a danger "per se" on emission from the exhaust.

All the evidence at present available gives no support whatsoever to this view and whilst it is not appropriate to deal with the matter in detail here, reference is made below to the most recent and authoritative medical statements on the subject.(6) Nevertheless, most European Governments have thought it desirable to prevent lead emissions to the atmosphere increasing with the amount of gasoline sold and this objective is being pursued by reducing the amount of lead permitted per litre of fuel. The E.E.C. have drafted a directive setting a maximum of 0·40 g/litre from 1 January 1976 for premium grade of minimum 98 Research Octane Number (RON) and regular grade of 90 RON. The directive also proposes a further reduction for regular grade alone to 0·15 g/litre maximum from 1 January 1978. This draft directive was drawn up before the recent crude oil supply difficulties, and future gasoline demand is now likely to be significantly lower than originally forecast, so much so that the dates of the introduction of the E.E.C. lead restrictions could be deferred for two years and still achieve the objectives envisaged. Whilst the E.E.C. proproposals are broadly acceptable to most countries in Europe provided they can be accommodated by the Crude availability, Germany has already enacted a Lead Law which requires that all gasoline produced or marketed in that country from 1 January 1976 shall have a lead content of not more than 0·15 g/litre. This unilateral action has caused embarrassment to other members of the E.E.C.

4. Impact of Lead Legislation on Energy Availability

4.1

These lead legislation proposals would have very significant effects on energy availability, particularly the German limit of 0·15 g/litre. In the short term, i.e. with existing refinery plant motor gasoline output would be reduced. In the longer term this could be corrected by the installation of additional plant, but at considerable capital cost and with increased fuel use in the refinery. The underlying factors involved are discussed below. The amount of gasoline products supplied in Western Europe in 1972 amounted to some 19 per cent of all oil products sold, 12·5 per cent being supplied as motor gasoline and the remaining 6·5 per cent as feedstock (naphtha) for the chemical industry. In the U.S.A. the situation is quite different, gasoline products forming nearly 50 per cent of refinery output. About one-half of the motor gasoline sold in Western Europe is produced in refineries without cracking facilities and which rely entirely on crude distillation and catalytic reforming for gasoline production. Some 60 per cent of existing European refineries are of this type. The remaining 40 per cent of refineries also incorporate cracking facilities of some kind in order to augment gasoline output by conversion of fuel oil components.

Shorter Term

4.2

The effect of lead legislation on energy availability in the shorter term can most clearly be seen by examining gasoline production in refineries without cracking units (Figure 1).

(a) Crude distillation separates the gasoline fraction from the rest of the crude oil. The material that emerges (straight run gasoline or naphtha) needs little further processing for use as a chemical feedstock. The lighter fractions (or tops) may also be suitable for blending direct into gasoline in restricted proportions.

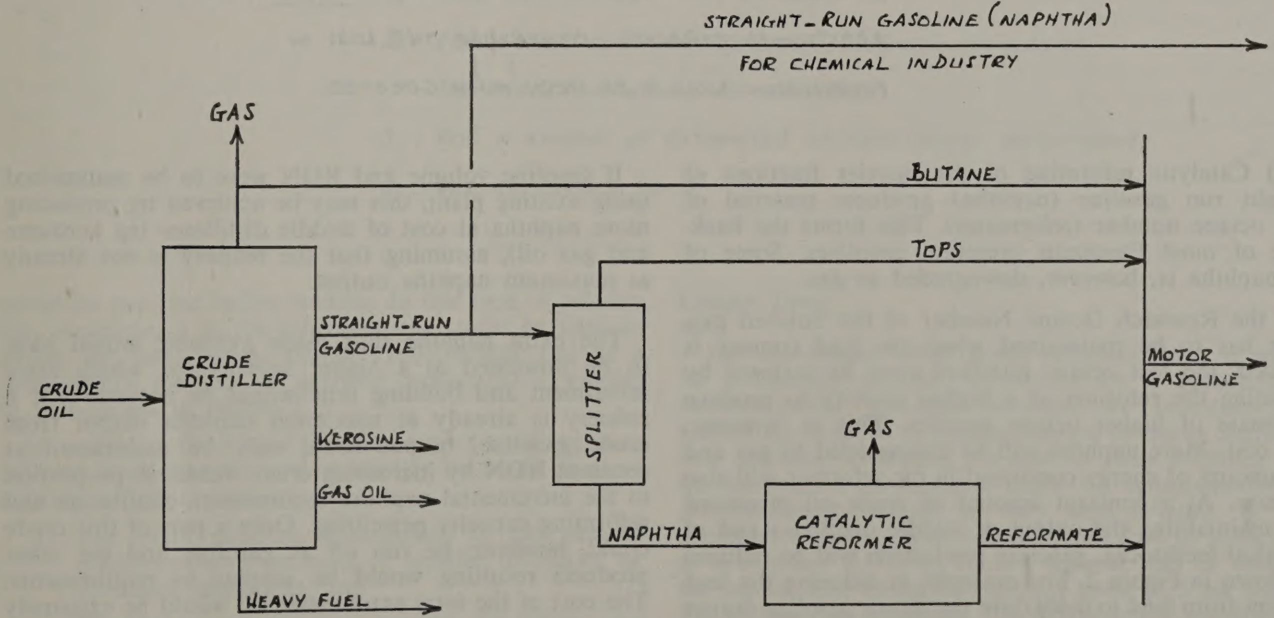

FIGURE 1 GASOLINE PRODUCTION IN A REFINERY OF THE DISTILLING/CATALYTIC REFORMING TYPE

60% OF EUROPEAN REFINERIES ARE OF THIS TYPE. THEY PRODUCE ABOUT 45% OF TOTAL EUROPEAN GASOLINE REQUIREMENTS.

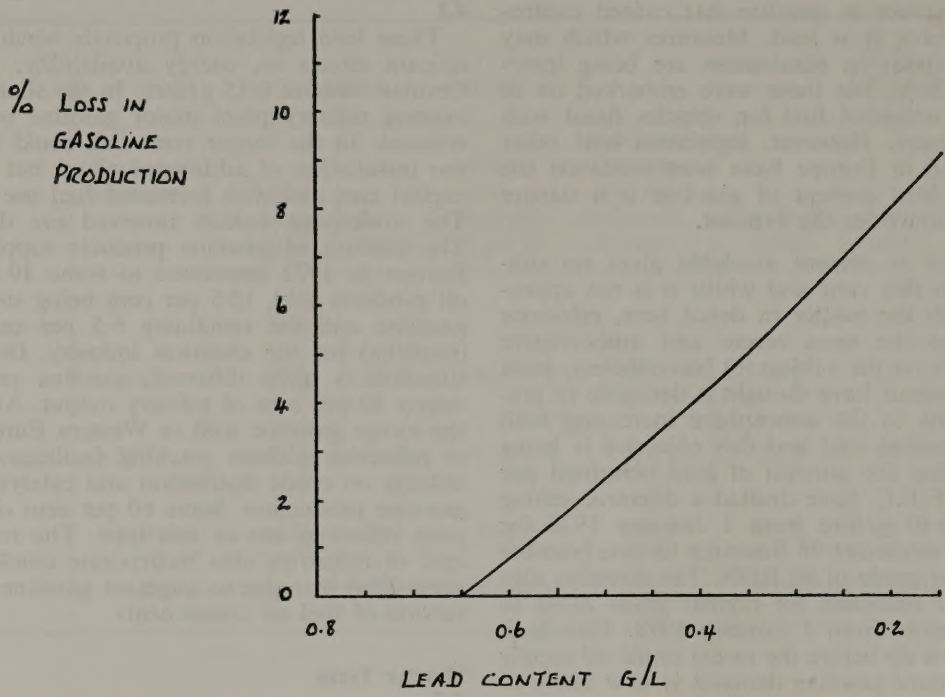

FIGURE 2 LOSS OF MOTOR GASOLINE PRODUCTION ON REDUCING LEAD CONTENT IN REFINERY OF DISTILLING/CATALYTIC REFORMING TYPE.

NOTES 1. FOR CONSTANT RON OF 98

2. ASSUMES CATALYTIC REFORMER CAPACITY IS NOT LIMITED. AT REDUCED LEAD LEVELS, THIS IMPLIES INVESTMENT IN ADDITIONAL CAPACITY, OTHERWISE THE LOSS IN PRODUCTION WOULD BE VERY MUCH GREATER.

(b) Catalytic reforming of the heavier fractions of straight run gasoline (naphtha) produces material of high octane number (reformates). This forms the backbone of most European premium gasolines. Some of the naphtha is, however, downgraded to gas.

If the Research Octane Number of the finished gasoline has to be maintained when the lead content is reduced, the lost octane numbers must be restored by operating the reformer at a higher severity to produce reformate of higher octane number. This is, however, at a cost. More naphtha will be downgraded to gas and the amount of energy consumed in the reformer will also increase. At a constant amount of crude oil processed and maintaining the output of middle distillates and of chemical feedstocks, gasoline production will be reduced as shown in Figure 2. For example, in reducing the lead content from 0·64 to 0·40g/litre the motor gasoline output would be reduced by some 4%. Capital investment will be required to modify many of the existing reformers, otherwise the loss of output would be very much greater, due to plant throughput being substantially reduced on increasing the severity of operation. For the same example of lead reduction from 0·64 to 0·40g/litre the loss of motor gasoline potential would be up to 15% if these modifications were not carried out.

If gasoline volume and RON were to be maintained using existing plant, this may be achieved by producing more naphtha at cost of middle distillates (eg kerosene and gas oil), assuming that the refinery is not already at maximum naphtha output.

The extra naphtha thus made available would have to be processed at a higher severity for which extra investment and building time would be necessary. If a refinery is already at maximum naphtha output from crude gasoline, output could only be maintained at constant RON by increasing crude intake in proportion to the incremental naphtha requirement, distillation and reforming capacity permitting. Only a part of this crude could, however, be run off as gasoline and the other products resulting would be surplus to requirements. The cost of the total extra crude oil would be extremely large.

The picture for the complex refineries incorporating conversion facilities is similar to that for the distilling/reforming type of refinery. Although they have additional processes producing gasoline (eg cat-crackers), the reformer is the only unit producing blending components with octane numbers in excess of the level required in

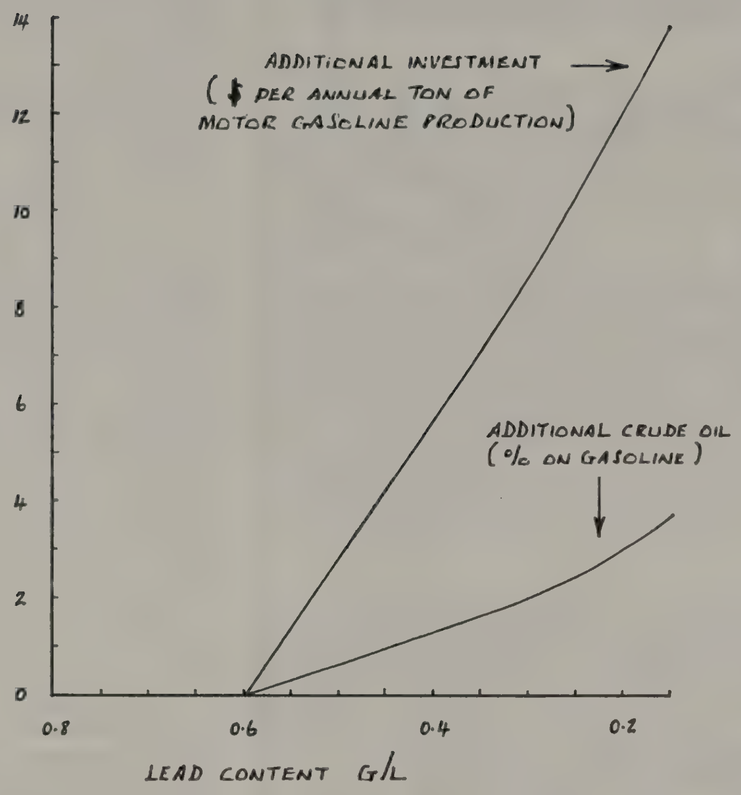

FIGURE 3 ADDITIONAL INVESTMENT AND CRUDE REQUIREMENTS TO MAINTAIN RON WITHOUT LOSING GASOLINE VOLUME.

NOTES
1. FOR RON OF 98
2. FOR LARGE COMPLEX REFINERY. IN SMALL REFINERIES THE PENALTIES WOULD BE GREATER.
3. FOR A RANGE OF ESTIMATES OF ADDITIONAL INVESTMENT, SEE REFERENCE NO. 7

premium gasoline before leading. In this type of refinery too, therefore, it is the reformate that must be used to adjust the final octane number requirement and as a consequence the loss of gasoline production is similar to that shown in Figure 2.

In summary, the loss of gasoline output resulting from reduced lead contents cannot readily be made good at existing refineries unless:

(a) The extra naphtha downgraded to gas can be made available at cost of middle distillates or chemical feedstocks, and

(b) The refinery has spare capacity to reform the increased amount of naphtha at the higher severity required.

The above conditions are not generally met at present. An alternative would be, providing spare reformer capacity exists, to import naphtha or crude oil. However, this availability cannot be taken for granted and the cost would be considerable.

Longer Term

4.3

For the longer term, given sufficient time, it would be technically possible to correct for a reduction of naphtha/motor gasoline potential by investment in additional facilities to convert fuel oil or heavy distillates into naphtha. However, the cost of these facilities and the associated incremental crude oil requirements for process energy would be very high (Figure 3). For example, to reduce lead content from 0·64 to 0·40g/litre at a constant RON of 98 and without loss of volume, the capital cost would be typically some $5·5 per annual ton of gasoline produced. The extra crude requirement would be about 1·3% on gasoline. For a total quantity of about 80 million tons of gasoline, as anticipated for the EEC in 1976, the investment cost would be some $440 million and the extra crude oil for process energy about 1 million tons.

For a reduction from 0·64 to 0·15g/litre these cost elements would be about three times higher.

In view of the competing demands for capital investment, eg in the search for additional energy sources, it is questionable whether such money is best spent in this way.

Notes of Caution

4.4

A few notes of caution should be added.

1. If the RON of the gasoline is kept constant when lead is reduced, the Motor Octane Number (MON) and the front end octane quality are likely to decrease and hence also the road anti-knock performance. If road performance were to be maintained, a small increase in RON would be required and this would result in a potential loss of gasoline greater than assumed above. Investment and crude oil penalties would then be correspondingly greater. Further, if the lead content itself contributes to road octane quality other than via RON, MON and front end octane quality, the problem would be accentuated even more. There is, however, considerable doubt from recent test data about the size or practical relevance of such ‘ lead bonus ’ effect.

2. The penalties of investment and crude oil cost relate basically to the optimum measures that could be adopted in a large sophisticated and complex refinery. In the actual European situation it would be impractical, for example, to erect conversion facilities in small simple refineries which would therefore have to rely on imports of high octane material or naphtha from complex refineries. Additional logistic penalties would then be involved.

5. Alternative Methods of Controlling Lead Emissions from Vehicle Exhaust

Reducing gasoline lead content is not, however, the only means of reducing lead emissions from vehicles. The lead can alternatively be trapped or filtered in the exhaust, and means of doing this have been developed. They would enable gasoline demand to be met more easily without incurring the cost of additional crude or naphtha imports or of additional refining facilities. (8) and (9).

6. Conclusions

It is clear, then, from what has been discussed above that while severe measures were necessary to control automotive emissions in certain parts of California, their extension to the rest of the USA could not be justified on the same environmental grounds, although it is accepted that there are practical reasons for country-wide legislation in the USA. The measures proposed for that country for 1976 are, however, costly both in terms of equipment and the extra fuel required. In the light of our present knowledge there is no justification for introducing such stringent controls in Europe, where climatic conditions are quite different from those in California and cars are smaller and fewer.

Controls should, however, be applied where there is a health hazard or where a nuisance pollutant can be reduced at reasonable cost. In drawing up such measures for Europe, harmonisation of trade within the EEC should be borne in mind. Before severe controls are considered, scientific and medical guidelines should be established to distinguish between what may be only an occasional nuisance and what is, in any sense, a health hazard. In this connection the work on exhaust emissions carried out by the UK Medical Research Council Atmospheric Pollution Unit under the stimulating direction of Professor Lawther has already provided much pioneer information and helped to establish a commonsense approach to what can so easily be a highly emotive subject.

While each constituent in the exhaust gases should be considered, their significance may be in conjunction with the others, not only because of possible synergistic effects but because the reduction of one pollutant may make it more difficult to control another—hydrocarbons and NO$_x$ are cases in point. However, it is not realistic to expect that action will rest solely on the scientific evidence. There is no doubt that public opinion in Europe is concerned about pollution generally and the smell of exhaust fumes is one of the things that is noticed most easily. The task of weighing up the social, medical and economic factors to arrive at a realistic synthesis is one for governments. In a future where gasoline will certainly be costly and possibly in short supply, serious thought is needed before embarking on any programme which will make even greater demands on energy availability without producing significant and measurable benefit to the environment.

7. Acknowledgments

The authors have presented this paper on behalf of the UK Petroleum Industry Advisory Committee (PIAC). They thank their colleagues in the industry for help and advice in the preparation of the paper, in particular H. Van Gulick, Shell Internatiole Petroleum Maatschappij, for help with the section on refinery implications.

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Environmental Health Officers' Association

From now on the Association of Public Health Inspectors is to be known as the Environmental Health Officers' Association.

The new name is a logical consequence of the changes brought about by the 1974 local government reorganisation, through which most of the Association's members employed by local authorities received the more accurate description of "environmental health officer".

With the 1974 changes in local government, the administration of environmental health became one of the major activities of the new 369 district councils in England and Wales. The old public health departments directed by Medical Officers of Health have been replaced by environmental health departments controlled by "Chief Environmental Health Officers", "Directors of Environmental Health Services" or officers with similar titles.

Royal Society of Health New Chairman of Council

The Royal Society of Health announce that Mr James Clancey has been appointed Chairman of the Council of the Society for the year 1975.

Mr Clancey who is Chief Inspector (Environmental Health) to the Greater London Council, was formerly Chief Inspector in the Public Health Department of the London County Council.

Since his appointment to the Council of the Royal Society of Health in 1963, Mr Clancey has been chairman of its Education and Examinations, Law and Parliamentary and Congress Committees.

He is also a Vice-President and Chairman of the Council of the Institution of Public Health Engineers, a Vice-President of the Association of Public Health Inspectors, a Deputy Chairman of the National Society for Clean Air and a member of the Council of the Institution of Environmental Sciences.

In addition, he is a Freeman and Liveryman of the City of London.

London Chemical Engineering Congress, 1975

The 1975 Congress of the London and South-Eastern Branch of the Institution of Chemical Engineers is to be held on 14th and 15th May, 1975, at the Portman Hotel, Portman Square, London W1. The Congress is arranged in three parallel sessions, during which seven symposia will be presented.

The symposia subjects are synthetic fuels, biological processes, the seven seas, new process routes, emission control, noice control and odour nuisance.

Further information may be obtained from David Walton, Conference Publicity Officer, The Institution of Chemical Engineers, Foster Wheeler House, Station Road, Reading, Berkshire RG1 1LX.

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New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Winter 1974)** *which gave the position up to* **30 September 1974.** *They now show changes and additions up to* **31 December 1974.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

As from 23 September 1974, the distinction between "black" and "white" areas has been discontinued. Because of this, the table showing the smoke control position in regions of England has been temporarily discontinued.

ENGLAND
NEW SMOKE CONTROL ORDERS IN OPERATION

Northern

Blaydon B.C. (No. 8), Boldon U.D.C. (No. 21), Darlington C.B. (No. 10), Gateshead C.B. (Nos. 16 and 17), Gosforth U.D. (No. 6), Hartlepool C.B. (Nos. 25 and 26), Jarrow B.C. (Nos. 11, 12, 13 and 14), Newcastle upon Tyne C.B. (Nos. 16, 17 and 18), South Shields C.B. (Nos. 12, 19 and 20), Sunderland B.C. (No. 13), Teesside C.B. (Nos. 16, 17, 18 and 19), Wallsend B.C. (Nos. 8, 9 and 10), Whickham U.D.C. (No. 16), Whitley Bay B.C. (No. 11).

North West

Accrington B.C. (No. 13), Ashton-in-Makerfield U.D. (No. 1, 1972), Birkenhead C.B. (No. 11), Blackburn C.B. (No. 15), Bolton C.B. (West Ward No. 6, Astley Bridge, Halliwell and West Wards), Darwen B.C. (No. 13), Eccles B.C. (No. 19), Farnworth B.C. (No. 8), Fulwood U.D. (No. 5), Glossop B.C. (No. 7), Horwich U.D. (No. 6), Lancaster C.B. (Nos. 7 and 8), Lancaster R.D. (Joint SCO), Leyland U.D. (No. 2), Marple U.D. (No. 7), Middleton B.C. (Rhodes No. 22), Oswaldtwistle U.D. (No. 6), Runcorn U.D. (Nos. 10 and 11), St. Helens C.B. (No. 9), Stockport C.B. (Shaw Heath/Cale Green—North), Westhoughton U.D. (No. 9), Whiston R.D.C. (Knowsley No. 3), Worsley U.D. (No. 14).

Yorkshire and Humberside

Barnsley C.B. (Nos. 21 and 22), Bentley with Arksey U.D.C. (No. 6), Dearne U.D. (Nos. 10 and 11), Doncaster R.D. (No. 3), Harrogate (No. 3 Valley Gardens and No. 5), Hemsworth R.D. (South Kirkby No. 1), Keighley B.C. (No. 9), Leeds C.B. (Nos. 115, 116, 117 and 118), Mexborough U.D. (No. 3), Swinton U.D. (No. 16), Wath upon Dearne (Nos. 8 and 9), York C.B. (No. 4).

West Midlands

Birmingham C.B. (No. 161), Dudley C.B. (No. 61), Leamington Spa R.B.C. (No. 15), Stoke-on-Trent CB (No. 27), Stourbridge B.C. (No. 34), Wellington U.D. (Salop No. 3), West Bromwich C.B. (Nos. 26 and 27).

East Midlands

Beeston and Stapleford U.D. (No. 15), Chesterfield B.C. (No. 8), Derby C.B. (Nos. 22, 25, 26, 27 and 28), Grantham B.C. (No. 22), Leicester C.B. (Nos. 34 and 35), City of Lincoln (No. 7), Lincoln C.B. (No. 9), Oadby U.D. (No. 1), Scunthorpe B.C. (No. 10), Southwell R.D. (Nos. 2 and 3) Sutton in Ashfield U.D. (No. 1, 1973), West Bridgford U.D. (Nos. 3 and 4).

Eastern

Basildon U.D. (No. 10), Bedford B.C. (No. 8), King's Lynn B.C. (Springwood, Marsh Lane and Marlborough Park), Luton C.B. (No. 12), Stevenage U.D. (Nos. 2 and 5), Watford B.C. (Nos. 10 and 11).

Greater London

Barnet L.B. (No. 16), Bexley L.B. (No. 13), Harrow L.B. (No. 29), Havering L.B. (No. 8), Hillingdon L.B. (Nos. 25 and 26), Kingston upon Thames L.B. (No. 23), Merton L.B. (Nos. 27 and 28), Newham L.B. (Nos. 11 and 12), Sutton L.B. (Nos. 29 and 30), Waltham Forest (Nos. 21 and 22).

Southern

Bletchley U.D. (No. 3), Bracknell (No. 4 Priestwood and No. 5 Bullbrook), Oxford C.B. (Nos. 13 and 14), Reading (No. 20 Lower Caversham), Slough B.C. (No. 16), Southampton C.B. (No. 14).

South East

Dartford B.C. (No. 13), Gillingham B.C. (No. 6).

South West

Bristol C.B. (No. 11), Crewe B.C. (No. 6).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern

Darlington (No. 12 Whinfield), Hartlepool B.C. (No. 27), Peterlee (No. 4), South Shields (No. 21), Stockton on Tees (No. 5 Albany Estate, Norton), Sunderland (No. 15).

North West

Bolton Metropolitan Borough (No. 2 Farnworth No. 9a), St. Helens (No. 10), Oldham (No. 21 Greenacres/Clarksfield), Rochdale B.C. (Freehold and Drake Street No. 1), Tameside (Stalybridge Nos. 17, 18 and 19), Warrington B.C. (No. 1 Stockton Heath/Grappenhall), West Lancashire D.C. (No. W.L.1), Wigan B.C. (Golbourne District No. 4), Metropolitan Borough of Wirral (Bebington).

Yorkshire and Humberside

Harrogate (No. 6 New Park and No. 7 St. Lukes), Sheffield (No. 28 Stocksbridge No. 3).

West Midlands

Nuneaton B.C. (No. 13), North Warwickshire B.C. (No. 1), Wolverhampton B.C. (Wightwick Area).

East Midlands

Ashfield District (Nos. 1 and 2), Broxtowe D.C. (Eastwood No. 1), Leicester (Nos. 36, 37 and 38), South Kesteven D.C. (No. 1 Grantham No. 23), Northampton (No. 12).

East Anglia

City of Peterborough (No. 3).

Greater London

Harrow (No. 32), Merton (No. 30), Newham (No. 13), Southwark (No. 31 Surrey Docks), Waltham Forest (Nos. 23 and 24).

South East

Gravesham (No. 1), Guildford B.C. (No. 3), Milton Keynes (No. 1 Bletchley No. 4), Oxford (No. 15), Slough (No. 17), Southampton (No. 16 Portswood and St. Denys), Stevenage Borough (Area No. 6).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern

Darlington (No. 11 Pierremont), Newcastle upon Tyne (Nos. 19, 20, 21, 21 Newburn, and 22).

North West

Atherton U.D.C. (Nos. 8 and 9), Bolton (No. 1 Little Lever No. 4), Brierfield (No. 8), Colne (No. 11), City of Manchester (Anson Road), Trawden.

Yorkshire and Humberside

Leeds (No. 119 East Hunslet Low Road).

East Midlands

Mansfield D.C. (No. 1), Newark D.C. (No. 4), Northampton (No. 11).

Greater London

Brent (No. 14), Bromley (Nos. 22 and 23), Kingston upon Thames (No. 24).

South East

Guildford B.C. (No. 2), Portsmouth (No. 2).

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Antrim D.C. (No. 4).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Castlereagh D.C. (No. 1).

SCOTLAND

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Bishopbriggs (No. 5), Dunfermline Pilmuir Street, etc), Grangemouth (No. 7), Lanark County (Blantyre West).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Bishopbriggs (No. 5), Falkirk (No. 12), Paisley (North End), Dunbarton County (Old Kilpatrick, etc).

AIR POLLUTION ABSTRACTS

1335 European problems and Solutions in Water Pollution. G. A. Truesdale, B.Sc., F.I.P.H.E.(Fellow), from Water Pollution Control, January 1975, No. 1.

The author considers that there are three overall situations that man-made pollution can cause, and each can be considered as occurring with different stages of social and industrial development. With each phase, the definition of pollution changes, and these phases are namely pathogenic pollution, gross pollution and new pollution. Each of these is described in relation to various European examples, together with suggested methods of eradicating such problems.

1336 Atmospheric Sulphur Dioxide in the United States. Can the standards be justified or afforded? William H. Megonnell. APCA January 1975.

With the use of extensive tables and diagrams the author discusses the possible over-exaggeration of the sulphur dioxide problems in the U.S.A. It is apparently generally acknowledged that the data base was insufficient for quantifiable, scientific definition of clean air when the national ambient air quality standards were adopted by EPA in 1971. Examination of the latest available ambient air quality data shows that the U.S. does not have a national sulphur dioxide problem. All these opposing ideas and data are naturally causing confusion among the public—what are they to believe? What are the facts and just how serious and widespread is the SO_2 problem in the U.S.A.—and does it indeed constitute a problem or resemble a hoax?

Although examination of the latest official reports list a few areas where the national standards are being exceeded, "close scrutiny of the data—gathered by a variety of inaccurate monitoring techniques reveals that such conclusions are suspect in many areas". To emphasise this point—recent epidemiological evidence suggests that no demonstrable health benefit has accrued as the result of dramatic reduction of sulphur dioxide concentrations in New York City.

1337 Motor Vehicle Generated Pollution in Urban Areas. John D. Butler, Stuart D. Macmurdo, Douglas R. Middleton, Department of Chemistry, University of Aston, Gosta Green, Birmingham.

The realisation of the influence of motor vehicles on the quality of urban atmospheres is not new, but extensive current research has been directed at investigating this phenomenon. This paper reports on observations of atmospheric pollution in the vicinity of the Midlands motorway link in Birmingham. The investigation was prompted by concern about the risk of damage by lead through the physiological or psychological action of lead, particularly among children. The first priority in this study was to obtain a factual analysis of the lead concentration at, and in the vicinity of the junction, Salford Circus. Other factors included an assessment of the influence of change of traffic density and of changes in meteorological conditions upon the concentrations monitored. The study also involved a simultaneous analysis of the blood lead levels of the local population.

1338 Wind Power: Low Area Energy Systems, by Andrew MacKillop. The Ecologist, Vol. 5, No. 1.

This is a general article dealing initially with the role of wind. It stresses that little work has been done on estimation of maximum possible energy extraction from the wind. The few estimates that exist of maximum extractable wind energy prove that wind is a very small source of energy by comparison with present human energy consumption. The article discusses types of machinery for the extraction of energy from the wind and possibilities of developing this on a viable economic scale. Presently economic and consumer prejudice are heavily against its wider use. However, wind energy at a local level seems an excellent non-depletable, non-polluting energy source.

1339 A Method for the Determination of Adiabatic Temperature and Gas Composition Resulting from the Burning of Sulphur-Containing Fuels. J. Csaba, Ph.D., Am.Inst.F.

A method is presented to calculate the equilibrium gas composition, resulting from the burning of solid, liquid or gaseous fuels with different air-fuel ratios, and different air preheat temperatures. The method takes into account the effect of the compounds of sulphur, besides those of carbon, hydrogen and oxygen, on both the adiabatic temperature and the composition of the resulting product. The method is illustrated with extensive equations, and graphs. The program explained is apparently a more accurate tool for the designer than the existing enthalpy-temperature charts, particularly for sulphur-containing fuels and for combustion in unusual circumstances, for example, with excess fuel.

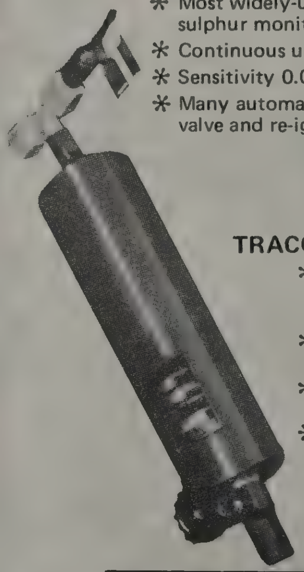
SMOKE CONTROL AREAS

Progress Report

Position at 31st December 1974

(Figures supplied by the Department of the Environment, The Welsh Office, The Northern Ireland Ministry of Development and the Scottish Development Department).

	England			Wales			Scotland			Northern Ireland		
Smoke Control Orders Confirmed prior to 30.9.74	4,429			19			241			59		
Acres		1,399,565			2,855			130,419			14,262	
Premises			6,265,596			10,499			551,207			34,882
Smoke Control Orders Confirmed (30.9.74-31.12.74)	23			—			4			1		
Acres		10,063			—			4,022			473	
Premises			107,650			—			8,781			2,238
Totals	**4,452**	**1,409,628**	**6,373,246**	**19**	**2,855**	**10,499**	**245**	**134,441**	**559,988**	**60**	**14,735**	**37,120**
Smoke Control Orders Submitted (30.9.74-31.12.74)	49			—			4			1		
Acres		29,917			—			4,175			60	
Premises			98,769			—			6,350			680
Grand Totals	**4,501**	**1,439,545**	**6,472,015**	**19**	**2,855**	**10,499**	**249**	**138,616**	**566,338**	**61**	**14,795**	**37,800**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—



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The Determination of Sulphur Dioxide in the Ambient Atmosphere—a Survey of Some Interference Effects

by

G. B. Marshall

This Paper describes interference effects encountered in the determination of sulphur dioxide in the ambient atmosphere. Both manual methods and automatic continuous analysers have been examined. In each instance the principle of operation is explained, followed by a discussion of possible interferences. In certain cases additional information, such as particular advantages of a method, has been given if thought to be relevant.

It has been shown that interference effects are quite prevalent in the determination of sulphur dioxide, but the reliability of an analytical method is dependent upon many other factors and these should always be taken into consideration.

1. INTRODUCTION

The purpose of this Paper is to outline some of the interference effects likely to be encountered in the determination of sulphur dioxide in the ambient atmosphere. The information has been abstracted from the available literature.

A recent review(1) stated that there are presently on the market approximately one hundred continuously-monitoring commercial instruments for sulphur dioxide. In addition to these there are a variety of manual analysers based on classical methods of analysis.

The manner in which this Paper has been written is as follows. The various methods have initially been divided into sections corresponding to the analytical procedure involved, e.g. titrimetric, colorimetric etc. Within these sections the methods have been further divided according to the analytical principle involved. In each case the principle is outlined and then a discussion presented on interference effects. Where thought to be relevant, additional information is given, e.g. particular advantages, cost, convenience, etc.

2. ANALYTICAL METHODS

2.1 Titrimetric

2.1.1 *Hydrogen peroxide method* (net acidity)

Sulphur dioxide (SO_2) is absorbed in a solution of hydrogen peroxide. This oxidizes SO_2 to sulphuric acid which is then titrated with standard alkali. This method, the British Standard method for the determination of SO_2(2), measures not SO_2 but the net acidity of the sample. It is insufficiently sensitive for instantaneous analysis and can only be used for average values of sulphur dioxide over a long sampling time (about 24 hours). Katz(3) has quoted a sensitivity of 0·01 p.p.m. using an air sample of 850 litres. The method has been stated to become less accurate at low concentrations of SO_2 (below 100 $\mu g/m^3$, 0·033 p.p.m.)(4).

Any acids in the air sample will give high results. Sulphur trioxide will also contribute to give high results. Ammonia will interfere by neutralizing absorbed SO_2 to give low results. Jacobs(10) states that hydrogen sulphide and volatile sulphides do not interfere unless present in large quantities. Titration to pH 4·5 ensures that there is no interference from dissolved carbon dioxide arising from normal atmospheric concentrations or from the reagents used(2). Moreover, if an appropriate filter is used, interference from acid mists and solid particles can be minimized.

2.1.2 *Thorin method*(5,6)

SO_2 is absorbed in a solution of hydrogen peroxide. The sulphate formed is then determined by titration with barium perchlorate in non-aqueous media using thorin as indicator. This undergoes a colour change of yellow to pink when excess barium ions are present. The end point is normally followed spectrophotometrically at 550 nm. The method has also been adapted for use with an auto-analyser(7). Sulphate is precipitated with barium perchlorate and the excess barium is determined colorimetrically with thorin. Katz(3) has quoted a sensitivity of 0·02 p.p.m. using an air sample of 1000 litres.

Heavy metals will interfere because of complexation with thorin. They can be removed beforehand, however, by a particulate filter. Phosphate, if present, can cause interference, but may be removed by precipitation with magnesium carbonate(5). Katz(3) has stated that "fluorides, in the concentrations normally found in urban air, do not interfere", but Killick(8) maintains that fluorides, found particularly as hydrogen fluoride in the vicinity of brickworks, do cause interference. The method is said to be very sensitive to pH change(9).

2.1.3 *Iodine method*

In this titrimetric procedure, described by Jacobs(10), air is bubbled into sodium hydroxide solution. This is subsequently acidified and the liberated sulphurous acid titrated with standard iodine solution using starch as indicator. A sensitivity of 0·01 p.p.m. with an air volume of 850 litres has been quoted(3). This method suffers from the disadvantage that the sodium hydroxide absorbing solutions cannot be stored for any appreciable time because of loss of SO_2 and also oxidation of sulphite to sulphate.

Nitrogen dioxide, ozone and oxidizing agents interfere to give low results. Hydrogen sulphide and reducing agents interfere to give high results.

2.1.4 *Iodine-thiosulphate method*

Katz(3) determined SO_2 by bubbling air through a solution of iodine, potassium iodide, starch and sulphuric acid. Iodine will oxidize SO_2 and the excess iodine is determined by titration with standard sodium thiosulphate. Sensitivity is quoted as 0·0024 p.p.m. with an air sample of 1000 litres(8).

Interference effects will be the same as in the previous method, i.e. oxidizing agents interfere to give low results, reducing agents interfere to give high results. There should be no interferences from acids, bases and salts.

2.2 Colorimetric Methods

2.2.1 *West-Gaeke method (T.C.M.)*(11)

This method forms the basis of the American E.P.A. reference procedure for manual measurement of SO_2.

Air is bubbled into a solution of potassium tetrachloromercurate, T.C.M., an absorber reagent which forms a stable dichlorosulphitomercurate complex with SO_2. Sulphamic acid is added to remove interference from nitrogen dioxide and the complex reacted with the dye reagent pararosaniline and formaldehyde to form the coloured complex of pararosaniline methylsulphonic acid. This is measured at 548 nm.

The method has many critical variables(12) which, if not rigidly controlled, lead to erroneous results. These include pH, temperature and the purity of the reagents. Solution pH affects the stability of the final colour, and also causes a spectral shift phenomenon; consequently phosphoric acid is added to stabilize the final solution. Temperature affects both the rate of colour formation and also the fading of the final colour; it is therefore necessary to use a constant temperature bath. Purity of the reagents, in particular pararosaniline, is important if reproducible results are to be obtained.

Automation of the complete E.P.A. reference method is not practical for continuous analysis of SO_2 because reagents have to be prepared freshly every day; also the response time of over 60 minutes would not facilitate measurement of short-term fluctuations in SO_2 concentration. However, there are commercially available continuous colorimetric analysers in use but these all modify the reference method to some degree in order to attain practical acceptance. This can be done in a number of ways, as outlined in a survey on 'Instrumentation for Environmental Monitoring' carried out at the Lawrence Berkeley Laboratory, University of California(13). For instance, it is possible to minimize the number of reagents used, alter the design of the absorber, and vary the absorber reagent and dye reagent. It must be emphasized, however, that if this is done specificity and reproducibility will be reduced.

Katz(3), has quoted a sensitivity of 0·005 p.p.m. with a sample of 38·2 litres of air.

This method has often been stated to be free from interference. For instance, Jacobs(10) says that the fuchsin method (actually the rosaniline method) is relatively specific for SO_2. It is probably preferable to say that interferences can be reduced to a minimum by following the procedure outlined in the E.P.A. reference method(14). As mentioned above, this method has many critical variables and so errors in the analysis can be introduced not by interference from foreign substances but by factors within the method itself.

Interferences and their control are discussed in the Lawrence Berkeley Laboratory survey(13). Principal interferences are ozone, nitrogen oxides and heavy metals. Ozone oxidizes SO_2 to sulphate and hence gives low values of SO_2. Its presence is counteracted by forming the dichlorosulphitomercurate complex (with T.C.M.), and this is stable against oxidation. A 20-minute wait before subsequent analysis allows any ozone to decompose. Nitrogen oxides cause fading of the coloured complex. Their presence is controlled by the addition of sulphamic acid followed by a 10-minute wait(15). Heavy metals interfere to give low values of SO_2(16), but interference can be removed by the addition of E.D.T.A. to the T.C.M. reagent and phosphoric acid to the pararosaniline.

Katz(17) has stated that the method is not subject to interference from other acidic or basic gases or solids such as sulphur trioxide, sulphuric acid, ammonia, or calcium oxide, but if inorganic sulphides, thiols, or thisulphates are present they must be removed by precipitation and filtration.

In its survey the Lawrence Berkeley Laboratory states that chlorine hydrochloric acid, hydrogen sulphide, and aldehydes are possible interferents(13), but their mechanism and effect are not detailed.

2.2.2 *Barium chloranilate method*(18)

Air is bubbled into a hydrogen peroxide solution converting SO_2 to sulphate. Solid barium chloranilate and 95% ethanol are added to this solution, buffered at pH4 with potassium acid phthalate. Excess barium chloranilate and barium sulphate are removed by filtration and the absorbance of the red-purple acid chloranilate ion formed in the reaction is measured at 530 nm.

Katz(3) quotes a sensitivity of 0·05 p.p.m. with an air sample of 1000 litres.

Carbon dioxide is said not to interfere, but phosphate, fluoride and chloride do interfere unless removed beforehand(17).

2.2.3 *Stratmann method*(19)

SO_2 from the air sample is adsorbed on silica gel in a quartz tube. The tube is heated to a temperature of 500°C and a stream of hydrogen passed through. The desorbed sulphur dioxide is reduced to hydrogen sulphide during contact with a platinum wire mesh catalyst at 600°C and this is absorbed in a solution of ammonium molybdate, sulphuric acid and urea. The absorbance of the molybdenum blue colour so formed is measured at 570 nm. A sensitivity of 0·01 p.p.m. with an air sample of 40 litres is quoted(17).

Sulphur compounds such as sulphuric acid, hydrogen sulphide and sulphur trioxide interfere, but sulphuric acid and sulphur trioxide can be removed by passage through phosphoric acid prior to the adsorption on silica gel(3). Water vapour in amounts greater than 300 mg interferes with the determination. This can be removed by passage through phosphorus pentoxide but not without loss of SO_2 in the process(17).

2.2.4 *Iodimetric method*(20,21)

SO_2 is absorbed from an air sample into a solution of iodine potassium iodide and starch. SO_2 is oxidized by iodine and the decolorization of the iodine solution is measured photometrically.

Katz(3) quotes a sensitivity of about 0·0023 p.p.m. with 1000 litres air sample. A continuous, portable meter designed by Cummings and Redfearn(20) is quoted to have a sensitivity of 1 p.p.h.m.

Interferences will be similar to those of the methods in sub-sections 2.1.3 and 2.1.4, i.e. oxidizing agents interfere to give low results and reducing agents interfere to give high results. Katz(3) notes that sulphuric acid, salts and bases (e.g. ammonia and calcium hydroxide) do not interfere. Moreover, he states that the effect of nitrogen dioxide is slight, because it is not well absorbed in the type of bubbler used. If high concentrations of nitrogen oxides or ozone are suspected, interference can be removed by introducing hydrogen into the air sample, and then passing the sample over a platinum catalyst at 100°C(22).

2.2.5 *Organic disulphide type dye methods*

Organic disulphide type dyes have been proposed by Humphrey *et al.* for the determination of SO_2(23). The two compounds studied were 4,4′-dithiodipyridine (4-PDS) and 5,5′-dithiobis (2-nitrobenzoic acid) (DTNB). SO_2, as sulphite ion, reacts quantitatively with the disulphide and forms a thiol anion. This is then measured spectrophotometrically,

$$RSSR + SO_3^{2-} \rightarrow RSSO_3^- + RS$$

The method has been compared to the commonly used West-Gaeke procedure and shown to have a number of definite advantages. It is, however, less sensitive. At present these dyes have not been field tested.

Humphrey states that there are three likely categories of interfering substances. These are metal ions which might precipitate the thiol; reducing agents that can reduce the disulphide; and oxidizing agents which could oxidize the thiol anion or the sulphite ion.

Humphrey tested the effect of a number of metals and found that the addition of E.D.T.A. was effective in removing interference except in the case of Hg (II) which interfered seriously at 20 p.p.m. in solution. Thiols, sulphide ion and thiosulphate were also quoted as serious interferents.

2.2.6 *Iron (III) reduction methods*

A number of methods have been proposed based on the reduction of Fe (III) to Fe (II) by SO_2. Fe (II) is then determined colorimetrically with reagents such as bathophenanthroline, 1,10-phenanthroline, T.P.T.Z., or ferrozine. In all cases sensitivity is less than that of the West-Gaeke T.C.M. method.

Stephens and Lindstrom have described a method using 1,10 phenanthroline(24). Hydrogen sulphide interferes seriously with the determination. The authors note that ozone can be tolerated up to 0·6 p.p.m. in a 100 litre sample(24). Acetylene, ammonia, butadiene, carbon dioxide, carbon monoxide, formic acid, hydrogen chloride, and nitrogen dioxide do not show any interference.

Attari *et al.* modified Stephens and Lindstrom's procedure and doubled its sensitivity. They reported that amounts of formaldehyde, nitric, nitrous oxide, and mercaptans comparable to SO_2 concentration had no apparent effect on the absorbance, but hydrogen sulphide interferes seriously. Chloride interferes if present in excess of 100 p.p.m.(25).

Stephens and Suddeth used T.P.T.Z. to measure the amount of Fe (II) formed in the reduction of Fe (III) by SO_2(26). This method is less temperature dependent and more sensitive than 1,10-phenanthroline. Manganese (II) and hydrogen sulphide interfere, moreover E.D.T.A. should not be added to prevent interference by metals as the chelating agent successfully competes with T.P.T.Z. for the Fe (II). Nitrogen dioxide and nitric oxide do not interfere.

Wende *et al.* used ferrozine as complexing agent(27). This is more sensitive than bathophenanthroline, 1,10-phenanthroline, and T.P.T.Z. Interference effects are similar to those experienced with 1,10-phenanthroline(13).

2.3 **Electroanalytical Methods**

2.3.1 *Conductimetric method*

Conductimetric analysers were the first commercially available instruments to monitor SO_2 and they are still in wide use today.

Air is passed through a dilute acidified solution of hydrogen peroxide, SO_2 is oxidized to sulphuric acid and the increase in conductivity of the solution is a measure of the SO_2 content of the air.

The technique has a fast response, requires minimal maintenance, and is simple to operate. Cummings and Redfearn quote a sensitivity of 1 p.p.h.m. for an automatic sulphur dioxide recorder(28).

Interference can be caused by any species that forms or removes ions from the peroxide solution. The measured conductivity depends upon the total ion concentration and therefore an interference may cause high or low results, depending upon whether it increases or reduces the total ion concentration.

The Lawrence Berkeley Laboratory Survey(13) gives information abstracted from the study by Rhodes et al.(29) in which eight conductimetric instruments were studied. This is reported in Table 1.

TABLE 1

Responses of Conductimetric Analyzers to Interferent Gases in the Presence of 1 p.p.m. SO_2

Gas	*Conc. (p.p.m.)*	*Instrument Responses*	
		Range p.p.m.	*Mean p.p.m.*
Cl_2	1	0·10 to 0·54	0·26
HCl	1	0·05 to 0·40	0·19
NO_2	1	0·02 to 0·06	0·03
NO	1	0·00 to 0·01	0·00
H_2S	1	0·00 to 0·01	0·00
O_3	0·5	0·00 to 0·02	0·00
CO_2	1000	0·00 to 0·08	0·02
†NH_3	0·92	−0·14 to −0·28	−0·21

†SO_2 concentration was 0·47 p.p.m.

As is seen, the worst interferents are chlorine, hydrochloric acid and ammonia. Salt aerosols, found along ocean coastlines, are also quoted as potential interferents(13).

Interference from ammonia is complex because initially conductivity will be reduced because of neutralization of absorbed SO_2 to form the salt ammonium sulphate. After neutralization, any further ammonia absorbed will cause an increase in conductivity owing to the formation of ammonium hydroxide(30).

It has been stated(13) that the degree of interference depends upon atmospheric conditions such as humidity, temperature, and particulate concentration, the concentration of the interferent, the concentrations of other species, including SO_2, and the particular instrument. Moreover, interference is not necessarily linearly related to the concentration of the interferent species.

There are means, however, by which interference can be minimized(13). In one instrument, a filter of potassium bisulphate and silver sulphate is incorporated to reduce interference from ammonia and salt aerosols; particulate matter interference has been reduced by a cellulose filter.

The manner in which the air sample is brought into contact with the peroxide also affects the degree of interference. Stevens(31) has shown that if the air is drawn across the surface of the peroxide instead of being bubbled through it, interference will be minimized because SO_2 will be preferentially absorbed compared with other species normally present in the atmosphere.

2.3.2 *Coulometric analysers*(32)

Coulometric analysers utilize the reaction of SO_2 with halogen. For instance, SO_2 reacts with Br_2 or I_2:—

$$SO_2 + 2H_2O + \underset{(I_2)}{Br_2} \rightarrow H_2SO_4 + \underset{(2HI)}{2HBr}$$

This reaction causes a depletion of Br_2 in solution. With variations, depending upon the particular instrument used, the current necessary to replace the Br_2 or I_2 lost from solution is measured and this is proportional to the amount of SO_2 absorbed into the solution, and hence present in the air.

The major advantage of coulometric analysers is that they require minimal maintenance and can be left in unattended operation. A typical sensitivity is given as 0·002 p.p.m.(13)

Species that can interfere with coulometric analysers are those that are able to oxidize halide, reduce halogen or complex with either. These include hydrogen sulphide, mercaptans, organic sulphides and organic disulphides. Without filters, sensitivity to these compounds is comparable to sensitivity to SO_2. Other potential interferences are ozone, nitrogen oxides, chlorine, ethene, aldehydes, benzene, chloroform, α-pinene, other halogen- or nitrogen-containing compounds and other hydrocarbons. Without filters, sensitivity to these species is usually much less than sensitivity to SO_2(13).

Each particular instrument has its own type of filter and therefore generalizations are difficult when assessing the ability of coulometric analysers to suppress interference. For instance, the Philips PW9700 has a heated silver gauze filter. This, it is claimed, will minimize interference from hydrogen sulphide, ozone, chlorine, nitrogen oxides, carbon disulphide, ethene, aldehydes, benzene and chloroform, but the instrument will respond to mercaptans.

There are other means of reducing interferences. Buffering the solution to pH 7 will reduce absorption of oxides of nitrogen; also if the solution is not agitated, absorption of species less soluble than SO_2 will be minimized(13).

2.3.3 *Electrochemical transducers*

These analysers are relatively new to the market. Introduced in 1970, they have the advantage of avoiding the wet chemistry involved in conductimetric, colorimetric and coulometric analysers. Their principles and characteristics are described in the Lawrence Berkeley Laboratory survey(13).

The current generated by the electrocatalytic oxidation of SO_2 at a sensing electrode is measured,

$$\text{i.e. } SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e^-$$

Sulphur dioxide selectively diffuses through a semi-permeable membrane and as a dissolved gas through the thin film electrolyte to the sensing electrode. The rate of charge removal at the sensing electrode, i.e. current, is linearly proportional to SO_2 concentration. Typical sensitivity is quoted as 0·01 p.p.m.(13) These analysers have yet to be field tested.

Potential interferences are species that are more easily oxidized than SO_2 and also diffuse through the membrane.

Selectivity is determined by the choice of semi-permeable membrane, thin film electrolyte, electrode material, and retarding potential. The membrane is selected to ensure that SO_2 diffuses through it in preference to other gases. The electrolyte is chosen to favour the oxidation of SO_2; for instance, the pH of the electrolyte could be adjusted to change the electrode potential in favour of SO_2 oxidation. The electrode catalyst material is chosen to favour SO_2 oxidation and the retarding potential is set sufficiently high to inhibit oxidation of species that are not as easily oxidized as SO_2. Specific interference data are given in the manufacturer's literature.

2.3.4 *Semi-continuous pH measurement*

Leithe(6) describes a method whereby SO_2 is determined by semi-continuous pH measurement. The air sample is first passed through phosphoric acid to remove ammonia, hydrochloric acid and sulphur trioxide. It is then passed into a hydrogen peroxide solution at pH5 containing a glass electrode. A similar air stream, used as a control, is passed into a T.C.M. solution to remove any SO_2. This is then passed into another hydrogen peroxide solution, again at pH5. The potentials of these two glass electrodes are recorded on a two-channel pH recorder and two parallel recorder traces result when SO_2 is absent. When SO_2 is present in the air sample, however, the pH of the measuring electrode will decrease in proportion to the amount of SO_2 present.

According to the data of the manufacturer, the instrument responds to SO_2 but not to hydrochloric acid, sulphuric acid, sulphur trioxide, nitrogen oxides, or ammonia(6).

2.3.5 *Polarographic determination*(3)

SO_2 contained in the air sample, is absorbed in a solution of sodium hydroxide and glycerol buffered at pH 3·9 and nitrogen is purged through the system to remove dissolved oxygen. Sulphurous acid is reduced at the dropping mercury electrode, at a half wave potential of $-0{\cdot}50$ V and the SO_2 concentration is calculated from a calibration curve of diffusion current plotted against concentration.

The method is based on the work of Kolthoff and Miller(33) and is recommended by the American Conference of Governmental Industrial Hygienists. It is less sensitive than colorimetric procedures; Katz quotes a sensitivity of 0·02 p.p.m. with an air sample of 840 litres(3).

Katz has stated that oxides of nitrogen do not interfere if present in the usual concentrations for urban air. He also states that other sulphur compounds do not interfere(3). Cystine does not interfere with the analysis, but

TABLE 2

Characteristics of Methods for SO_2 Analysis

Method	*Sensitivity*	*Interferences*	*Relevant factors*
Net Acidity—Hydrogen Peroxide	0.01 p.p.m. (850 litres air) (3)	Any acids in the air. Ammonia and any other basic species.	Static sampling. Simple procedure.
Thorin	0.02 p.p.m. (1000 litres air) (3)	Heavy metals unless removed by particulate filter. Phosphate unless removed by precipitation. Fluoride.	Static sampling. Method sensitive to pH change.
West-Gaeke (T.C.M.)	0.005 p.p.m. (38.2 litres air) (3)	Can be made relatively specific but this involves a lengthy procedure.	Static sampling. Errors can be introduced by temperature effects and impurity of pararosaniline.
Conductimetric	0.01 p.p.m. (28)	Any species that forms or removes ions from solution unless measures are taken to prevent absorption of these species.	Continuous operation, fast response, minimal maintenance, simple to operate.
Coulometric	0.002 p.p.m. (13)	Species that are able to oxidize halide, reduce halogen, or complex with either; unless these species are removed beforehand by filters.	Continuous operation, minimal maintenance, can be left in unattended operation.
Electrochemical Transducers	0.01 p.p.m. (13)	Relatively specific, but a sparsity of information at present.	Continuous operation, no wet chemistry involved, have yet to be field tested.
Flame-Photometric Detectors	0.005 p.p.m. (13)	Any other sulphur species present. Can be made specific if coupled to a gas-chromatograph.	Continuous operation, fast response.
Correlation Spectrometers	10 p.p.m. × meters (43)	Acetone, ozone	Continuous operation, no chemical reagents, remote sensing capability.

will react with SO_2 while in the hydroxide collecting medium, the disulphide group being reduced by SO_2 to the sulfhydryl radical.

2.3.6 *Differential pulse polarographic determination*

Garber and Wilson[34] describe a method whereby SO_2 is absorbed into a solution of dimethyl sulphoxide containing a supporting electrolyte. The solution is de-aerated and a differential pulse polarogram is run cathodically, resulting in a peak between $-0{\cdot}7V$ and $-0{\cdot}8V$ against the silver-silver chloride reference electrode, caused by the reduction of SO_2. Peak height is proportional to the concentration of SO_2. This method has the advantage of being considerably more sensitive than the previously described polarographic procedure (sub-section 2.3.5). The authors quote a sensitivity of 0·04 p.p.m. with an air sample of 5 litres.

Nitrogen oxides are said to interfere if present in amounts greater than 1/10 of the concentration of the SO_2. Traces of hydrogen sulphide and sulphuric acid do not interfere, neither does oxygen, provided that it has been removed by nitrogen de-aeration. Water does not interfere if present at less than about 5% w/w, but at very low water concentrations the electrochemical reduction of SO_2 may be different, and at high water concentrations the solvent properties of dimethyl sulphoxide are altered[34].

2.4 **Gas-Chromatographic/Flame Photometric Detectors**[35]

These instruments can be either simple flame photometric detectors or a gas chromatograph coupled to a flame photometric detector. Flame photometric detectors measure the intensity of the S_2 band emission spectra produced when sulphur species are introduced into a fuel-rich hydrogen flame. If a flame photometric detector is coupled to a gas chromatograph an instrument results that is able to resolve the various sulphur species present before they are measured spectrophotometrically. Flame photometric detectors are simply sulphur specific because they respond to all sulphur species present in the atmosphere, whereas gas chromatograph/flame photometric detectors can be rendered sulphur dioxide specific because of the pre-resolution stage.

A typical sensitivity for a flame photometric detector is about 5 p.p.b.(13) These instruments have the advantage of high sensitivity, good specificity, and fast response time but suffer from the disadvantage of needing bulky gas cylinders to supply hydrogen.

Particulate matter and aerosol spray could potentially interfere either by clogging jets or scattering light.

Flame photometric detectors operating without pre-resolution by gas chromatography will be subject to interference from any other sulphur species present.

Gas chromatograph-flame photometric analysers have been stated to be not ordinarily susceptible to interference(13).

2.5 **Correlation Spectrophotometric Detectors**

Correlation spectrometers are briefly reviewed by Hollowell et al.(32). The data obtained may be either long line average in units of p.p.m. meters or point values. Long line average data may be converted to conventional point values by dividing by the measured path length. Correlation spectrometers can use either skylight or an artificial light source, such as a quartz iodine or xenon arc lamp. These spectrometers employ correlation masks, manufactured by depositing aluminium onto a quartz plate and then removing slits of aluminium corresponding to the absorption spectrum of SO_2. Light passes through the atmosphere containing SO_2 and is collected by a telescope, collimated, dispersed and focused onto the correlation mask. The mask is repeatedly moved relative to the incident spectrum of SO_2, and the difference in signal of the photomultiplier detector when the mask correlates with the SO_2 spectra, and when it does not, is proportional to the amount of SO_2 present.

Correlation spectrometers have the advantage of using no reagents, show good potential for continuous operation, and have remote sensing capability. They have the disadvantage that the observed path length must be precisely known in order to convert p.p.m. meter values into p.p.m.(13).

Interference effects were studied by Moffat et al.(36). They found no interference from H_2S, NH_3, CO_2, CO, CH_4, NO, NO_2, C_6H_6, CH_3OH, Cl_3HC_2, $CH_3CH_2CH_2OH$ and xylene-toluene mixtures; but acetone at 150 p.p.m. gave a 25 p.p.b. SO_2 response. Ozone at 0·1 p.p.m. gave no SO_2 response but at concentrations of 3 and 7 p.p.m. SO_2 responses of 10 and 25 p.p.b. were recorded.

2.6 **Static Sampling Methods**

2.6.1 *Lead dioxide sulphation method*(37)

This method utilizes the reaction of lead dioxide with SO_2 to form lead sulphate:

$$PbO_2 + SO_2 \rightarrow PbSO_4$$

Sulphate is then determined as barium sulphate either gravimetrically or turbidimetrically. In this way a method is obtained that gives the total exposure to SO_2 over the sampling period. The lead dioxide method has the advantage of being very inexpensive but its reliability and accuracy is very dependent on a number of critical variables.

Interferences can be both physical and chemical. In the original paper of Wilsdon and McConnell(38) it is reported that temperature decreases the sulphation rate. In addition, the presence of dust, turbulence of the air and moisture all affect the sulphation rate. Bowden(39) also states that the sulphation rate is affected by the shape of the surrounding shelter—round shelters giving 20% more sulphation than square ones. The Lawrence Berkeley Survey(13) states that the consistency of lead dioxide both within batch and between batches is difficult to control. This means that the surface area of any particular lead dioxide sulphation plate could vary and hence give different sulphation rates. Factors which affect surface area are the size of lead dioxide particles, and the density and thickness of the layer.

Chemical interference is found if hydrogen sulphide, sulphur, sulphate aerosols such as sulphuric acid mist and ammonium sulphate, or mercaptans are present(37).

2.6.2 *Impregnated filter paper methods*

A number of procedures have been described whereby SO_2 is absorbed into impregnated filter papers, and then determined colorimetrically.

For example, SO_2 has been collected on alkali-treated filter paper (20% potassium hydroxide + 10% triethanolamine or glycerol)(40,41). It is subsequently leached from the filter paper by washing with water and determined colorimetrically by the West-Gaeke method. In another method SO_2 is collected on a zinc acetate impregnated filter, the zinc sulphite so formed is then determined colorimetrically with a dye solution containing sodium nitroprusside(42). Bourbon et al.(42) state that no major chemical interference was observed with their technique.

There is a sparsity of information on potential interferences likely to be encountered with impregnated filter methods but it is thought that physical factors, for instance humidity, could affect results.

3. **DISCUSSION**

In assessing the relevance of chemical interferences it is important to realize that incorrect analytical results can occur because of factors other than the presence of chemical interferents. Such factors can, for instance be operator errors associated with lengthy chemical procedures, physical effects such as temperature, humidity, and collection efficiency of absorber reagents, and faulty behaviour of chemical instrumentation.

It is also important to realize that because a species is not listed as interfering it does not necessarily mean that it does not interfere. It could mean that field work has been insufficient to yield the relevant information.

The International Standards Organisation are presently considering four methods for the analysis of ambient SO_2. These are the "net acidity method", the thorin method, the West-Gaeke, (T.C.M.), method and instrumental methods in general. Characteristics of the three manual methods and the more common instrumental methods are given in Table 2. It is evident that each method has its own particular attractive features and the choice of a suitable method will depend not only upon susceptibility to interference but also upon practical considerations. For example, if a potential interferent can be guaranteed to be absent, there is no need to employ a more elaborate or expensive form of analysis when a simple method will suffice.

4. CONCLUSION

Interferences encountered in the determination of SO_2 in the ambient atmosphere by various methods have been surveyed, and shown to be quite prevalent, but the reliability of an analytical method is dependent upon many other factors and these should always be taken into consideration.

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National Society for Clean Air

136 North Street, Brighton BN1 IRG (Brighton 26313)

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L. Morgan, 9 Lodge Drive, Baglan, Port Talbot (5231)

SUBSCRIPTIONS

(*The following is an extract from the current Bye-laws of the Society*).

2. Annual Subscriptions shall be as hereinafter provided. A first annual subscription shall be made on application for Membership and shall continue in force until the first day of April of the following year, when it shall be renewable.

(a) Individual Members
The annual subscription payable by an Individual Member shall be not less than Three Pounds. On attainment of the age of 65 on payment of a sum of Ten Pounds, Individual Members may, at the discretion of the Council retain their membership of the Society in perpetuity, but always subject to the Council's rights of removal.

(b) Student Members
The annual subscription payable by non-graduate students pursuing their studies at school, college or university shall be One Pound.

(c) Local Authority Members
The annual subscription payable by a Local Authority shall be not less than as follows. For Local Authorites with a population of:

Less than 100,000	£ 50.00
100,001 to 250,000	£ 60.00
250,001 to 500,000	£ 75.00
500,001 to 1,000,000	£100.00

For each additional 500,000 or part thereof £10.00

(d) Corporate Members and Unincorporated Bodies appointed in accordance with Article 4(e) (ii)
The annual subscription payable by Corporate Members and Unincorporated Bodies shall be not less than as follows:
  (i) Small local civic societies, colleges, schools and similar organisations £5.00
  (ii) Regional and national societies and similar organisations, consultants and small industrial and commercial firms £30.00
  (iii) Industrial organisations £50,00

(e) Sustaining Members
The annual subscription for Sustaining Members shall be not less than £100.00.

(f) Membership—Special Cases
The Council shall have power to elect any applicant for Membership to an appropriate grade of Membership, on such special terms as to subscription or otherwise as after considering any reasons for so doing stated by such applicant the Council may think proper.

National Society For Clean Air

NEWS FROM THE DIVISIONS

NORTHERN DIVISION

On the 14th February 1975 the Inaugural Annual General Meeting of the Northern Division took place in the Civic Centre, Newcastle upon Tyne. Because of local government reorganisation and the consequences of the reconstruction of the Society, some difficulty had been encountered by the Secretary in compiling a register of members and representatives of members, one of the principal causes being the drastic changes in geographical boundaries of both local authorities and the Division itself. Whereas the former North East Division comprised Northumberland, Durham and the Cleveland District of Yorkshire with 75 local authority members, the new Northern Division now included the counties of Cleveland, Cumbria, Durham, Northumberland and Tyne and Wear comprising a total of 29 local authorities, 18 of which are now members of the Society.

A total of more than 50 members were welcomed by Councillor T. W. Yellowley, Vice-Chairman of the Health and Environment Committee of the City of Newcastle upon Tyne, who offered best wishes for the success of the newly created Division.

A notable feature of this inaugural meeting was the presence of the Secretary General, Rear-Admiral Sharp. The Secretary General delivered a short stirring address in which he emphasised the need for 100% membership of local authorities and that there was still much work ahead in achieving this aim. He continued by referring to the widening sphere of pollution in which the Society was taking an interest and indicated that one of the reasons for the re-structuring of the Society was to enable these wider horizons to be brought into focus. In this connection he mentioned that the Seminar to be held in Newcastle upon Tyne in March had been a "sell out" and this was an encouraging indication of the interest not only in clean air, but in associated problems of toxic wastes, effluents, flue gases, etc. He concluded by referring to the financial restrictions upon local authority expenditure, but strongly expressed the view that the North East should be regarded as a special case in this matter and hoped that local authorities would not take any action to slow down smoke control.

Another unusual feature of this occasion was that it was the last appearance as Chairman of B. N. Young, O.B.E., who had served the Division as a representative for almost thirty years, most of which time he had occupied the office of Chairman, as well as being a Divisional Representative on the Executive Council of the Society. In his farewell address, copies of which had been printed and distributed, he reviewed the progress which had taken place in air pollution abatement in the North East during his membership of the Division and he offered his good wishes to his successor and to the future progress of the newly constituted Division.

In reply, Professor P. C. G. Isaac, Vice-Chairman, praised the excellent service given by Mr. Young and he moved a vote of thanks which was carried with acclamation.

The election of officers resulted in Councillor L. Poole of Middlesbrough being elected as Chairman, Professor P. C. G. Isaac of the University of Newcastle upon Tyne and Councillor T. W. Yellowley of Newcastle upon Tyne being elected as Vice-Chairmen, Mr. L. Mair being re-elected as Honorary Secretary and Mr. A. S. A. Archer, City Treasurer Newcastle upon Tyne being elected as Honorary Auditor.

At least a week before the date of the meeting the Honorary Secretary had received four nominations for the three vacancies for Divisional Representatives on the Council and in accordance with the provisions of the Byelaws, a ballot was held at the meeting. This ballot resulted in the election of Mr. L. Mair of Newcastle upon Tyne, Councillor L. Poole of Middlesbrough and Councillor R. J. K. Shepherd of Carlisle as Divisional Representatives. Mr Mair, speaking as Honorary Secretary, indicated that one-third of these representatives would be retiring each year and further stated that he himself would be serving only until the next Annual Meeting.

Much consideration was given to the constitution of the new Northern Divisional Council. The Honorary Secretary reminded members that a constitution for the former North East Division had been drafted, submitted to and approved by the Executive Council in March 1972 and he explained how the process of reorganisation had prevented the adoption and operation of this new constitution. In view of the very different boundaries and the changed membership of the Northern Division he suggested that a new constitution would have to be devised and it was resolved that a Sub-Committee be set up to consider, formulate and approve a new draft constitution for submission to the next Divisional meeting.

Under 'Any Other Business' a very vigorous discussion took place concerning the meeting referred to by the Secretary General in relation to smoke control activity in th Northern Region. It was pointed out that smoke control activities in the North East Region had been under the careful and prolonged scrutiny of an

Investigation Panel of the Clean Air Council during 1972, which was followed by a very frank report urging North Eastern authorities to become aware of their social responsibilities in the matter of air pollution control and to formulate and implement programmes of smoke control for completion by the early 1980s. Most local authorities had, it was said, responded magnificently and the consequences of the implications in Para. 39 of Circular 171/34 could be disastrous from an air pollution control point of view.

It was resolved that the Society submits suitable representations to the Clean Air Council urging that the North East Region be regarded as a special case in relation to the restrictions implied in Circular 171/74 and that a copy of such representations be sent to the Secretary of State for the Department of the Environment.

At the close of the meeting tea and refreshments were served at the invitation of the Newcastle upon Tyne City Council.

DIARY OF EVENTS 1975

18th-20th March
4th Clean Air Spring Seminar
"Grit, Dust and Fume"
Newcastle-upon-Tyne

27th March (Thursday)
East Midlands Divisional Meeting
Derby

10th April (Thursday)
Meeting of Conference and Publicity Committee
London

11th April (Friday)
Meeting of Scottish Division
City Hall, Glasgow

25th April
Copy date for Summer Number of "Clean Air"

30th April
Annual General Meeting of London and South East and Central Southern Divisions
London

1st May (Thursday)
Meeting of Honorary Secretaries of Divisions
Brighton

8th May (Thursday)
Meeting of General Purposes and Finance Committee
London

15th May (Thursday)
Meeting of the Council of the Society
London

9th July (Wednesday)
1400 Annual General Meeting of the Society
1500 Installation of the President and Public Meeting
The Guildhall, London

20th-24th October
International Clean Air and Control of Pollution Conference (incorporating 42nd Clean Air Conference)
Brighton

RESEARCH SITUATIONS WANTED

Environmental Science at Bradford University is a four-year degree course of which the third year is spent in selected work outside the University.

Positions are required for third-year students, possibly as assistants for surveys, investigation and research of various kinds. During the year it should be possible for a student, backed by his University tutors, to undertake and complete a piece of work really useful to his employers. Salary required: approx. £1,200.

Further information may be obtained from: Roy Lorrain-Smith, School of Environmental Science, University of Bradford, Richmond Road, Bradford, West Yorkshire, BD7 1DP. Phone: Bradford 33466.

The Second Sir Hugh Beaver Memorial Lecture

CLEAN AIR OVER LONDON

by

Lord Ashby, F.R.S.

I

Exactly twenty-two years ago today preparations were under way for the Smithfield show of livestock at Earls Court. On Friday, December 5, the animals began to arrive for the show, which opened on the following Monday. And it was on that Friday that an unusually unpleasant fog descended on London. Londoners were used to fogs. Their reaction to it was described afterwards as 'strangely calm . . . almost fatalistic' (1). On Monday the fog was still as thick as ever and *The Times* reported that some of the cattle were suffering from respiratory trouble. An Aberdeen Angus died; 12 others had to be slaughtered; and about 160 of them had to be treated by vets (2).

These were the first reported casualties of the smog of 1952. There were other unusual incidents. At Sadlers Wells the opera *La Traviata* had to be abandoned after the first act, because the theatre was so full of fog (3). By the following Wednesday the fog had cleared, and the first complaint appeared in the form of a letter to *The Times*: Could a nation which had television, radio-telescopes, atomic energy, and jet propulsion find no remedy for fogs? Then came parliamentary questions. On 18 December the Minister of Health (Iain Macleod) was asked how many additional deaths had occurred due to the fog in the Metropolitan area. During the week ending 13 December, he replied, there had been 4703 deaths, compared with 1852 in the corresponding week in 1951. Two days later, on 20 December, *The Times* reported that the executive of the National Smoke Abatement Society had been asked to press for an 'immediate and intensive' official investigation into the fog. About five months later, on 8 May, the Minister of Housing and Local Government set up the Beaver Committee. Three years later the Clean Air Act (1956) received the royal assent.

It is a familiar episode in recent history. In this lecture I want to reflect upon some of its implications. Was it the 1952 fog which brought about the Clean Air Act? What were the intermediate links in this chain of events? And—my main theme—why did England, bedevilled by smoke since the industrial revolution, have to wait until 1956 before there was effective legislation to control it?

Let me first remind you of the familiar story. At the end of January 1953 the LCC produced a dramatic report on the fog (4). It included figures for the deaths per million inhabitants in the LCC area after four major health disasters in the last 100 years, and the excess of deaths attributable to the disaster. Here, in figures per million inhabitants, are the weekly death rates:

date: week ending	4.8.1866	20.12.1873	19.11.1918	13.12.1952
cause	cholera	fog	'flu	fog
deaths (total)	876	713	1085	745
normal no. of deaths	450	470	300	300
excess of deaths over normal	426	243	785	445

The increase in deaths in the 1952 fog was due almost entirely to circulatory or respiratory disorders. Two challenging conclusions are evident from these figures. The first is that the 1952 fog was as great a disaster as the cholera outbreak in 1866. The second is that deaths through fog are no new thing; they were occurring and being recorded at least 80 years before 1952.

When Parliament reassembled on 20 January, the Government was pressed to take some action. Day after day, Mr. Dodds, Lt. Col. Lipton, and others, tackled ministers at question time. Mr. Macleod (Health), Mr. Macmillan and Mr. Marples (Housing and Local Government), Mr. Peake (National Insurance), Mr. Molson (Works) all prevaricated. The Ministry of Health, said Mr. Macleod, is concerned with the effects rather than the causes of fogs; so he did not think it necessary to have a representative of his department on the Atmospheric Pollution Research Committee (5). 'I am not satisfied', said Mr. Macmillan, 'that further general legislation is needed at present'. And when pressed to urge local authorities to exercise the powers over smoke which they already possessed, his reply was: 'We do what we can but the hon. gentleman must realise the enormous number of broad economic considerations which have to be taken into account . . .' (6). By the end of January Messrs. Lipton and Dodds were, not surprisingly, accusing the Government of complacency and apathy. Throughout February and March the sniping in Parliament continued. Several disquieting facts were squeezed out of reluctant ministers. Twelve local authorities, for instance, had powers by Local Acts to establish smokeless zones, but only two of them (Coventry and Manchester) were operating under these Acts (7). The Press kept up its interest, too. The *Evening Standard* reported Mr. Macleod as protesting: 'Really anyone would think fog had only started in London since I became Minister' (8). But restlessness among the public, reinforced by pressure from MPs and the LCC, elicited a promise on 8 May that a committee of enquiry would be set up, though it was not until 21 July that the Government announced that Sir Hugh Beaver would be its chairman. Thereafter the stock reply to all further parliamentary questions about smoke abatement was: we must await the report of the Beaver Committee.

They did not have to wait long. Four months later the Committee submitted its first report (9) and its final report followed a year later (10).

The reports are classics in the literature of technological advice to governments. They are familiar, I am sure, to everyone in this audience. They include a pioneer cost-benefit analysis of the damage done by polluted air. The two prime recommendations were (i) that the emission of dark smoke should be an indictable offence, without obliging someone to prove in court that it is a nuisance; and (ii) that local authorities should be empowered under general legislation (instead of having to bring in individual Acts of Parliament) to establish smokeless zones or smoke control areas. For the first time on a national scale domestic chimneys were to be included in any such legislation.

The final report (unlike the hurriedly prepared interim report) received an accolade of praise from Press and Parliament, and its recommendations were accepted in principle by the Government. But there were still two impediments to be overcome. The first was the possibility that public interest (and hence political concern) might evaporate, for the 1952 fog was now two years away. The second was to find room in a packed parliamentary programme to introduce a Bill. Sir Hugh Beaver helped to overcome the first impediment by evangelizing for clean air in numerous addresses all over the country. And the chief credit for overcoming the second hazard goes to Gerald Nabarro. He, and a number of other MPs, decided that if any of them won the ballot for a private members' Bill, the Bill should be for Clean Air. Nabarro won the ballot and, thoroughly briefed by the National Smoke Abatement Society, he introduced a Bill which, in his own words, was: 'Beaver, nearly the whole of Beaver, and practically nothing but Beaver.' He plunged into the campaign with characteristic panache. He is said even to have had his outgoing mail stamped: "Gerald Nabarro's Clean Air (Anti-Smog) Bill. 2nd reading, Friday, 4 February 1955" (11).

You know the rest of the story. MPs were virtually unanimous in their support of the measures proposed in the Bill, though one Tory did remind the House that a 'Bill which imposes a penalty . . . on a British householder for burning British coal in a British grate needs careful scrutiny' (12). The Bill was withdrawn on a promise by Duncan Sandys that a Government Bill, with the necessary financial provisions, would be introduced. The Government Bill was weaker than Nabarro's Bill, by reason of the escape clauses which (in Nabarro's view) had been inserted under pressure from the FBI. (A 'little mouse of a Bill', Jennie Lee called it (13). But it reached the Statute book and we now enjoy its benefits.

Whom do we thank for these benefits? The fog? The National Smoke Abatement Society? Sir Hugh Beaver? Messrs. Dodds and Lipton and others who pestered the Government? Gerald Nabarro? Or the Government itself?

Certainly not the Government. There are occasions when ministers are ahead of public opinion, when they really give leadership in social reform. But over clean air it was the public which led; the Government followed; and followed only when, as Duncan Sandys admitted, there was no difference of opinion 'in this House and very little outside' (14). Do we have to thank the fog? Yes. The public conscience was aroused by the dramatic and prompt disclosure of the 4000 additional deaths, though (as Lord Macdonald reminded the House of Lords) they had to die in London in order to get the attention of Parliament (15). But why the 1952 fog rather than the fogs (pretty bad by all accounts) of the 1870s to 1890s?

I think this question can be answered, but first we have to put the Beaver Report into the perspective of history. The campaign for a Clean Air Act can be said to have started about 150 years ago. To trace the tortuous story of national and local legislation would take a whole course of lectures. All I can do in one lecture is to pick out two episodes in this story and to skate over the long intervals in between. My reason for selecting these two episodes will, I hope, emerge at the end of my talk.

II

Essays on air pollution commonly cite picturesque incidents from the times of Edward I and Elizabeth I, when proclamations were issued forbidding the use of coal in London while Parliament was sitting (16); and how (for instance) in 1371, there were complaints about the smoke being made by two plumbers in St. Clements Lane, Eastcheap, and they were ordered to heighten their chimney for the benefit of the people living in the neighbourhood (17). But these were measures against sporadic, local, nuisances. It was not until 1819 that Parliament showed signs of recognising that smoke was a matter for public concern. In that year a committee proposed by Michael Angelo Taylor was appointed to enquire 'how far persons using steam engines and furnaces could erect them in a manner less prejudicial to Public Health and Public Comfort.'

This committee in 1819 marks the beginning of the long gestation which ended in the Clean Air Act 1956. It was the first in a procession of enquiries, followed often by abortive Bills, sometimes by cautious, and invariably insufficient, legislation. The committee concluded that smoke was prejudicial to health and that smoke-prevention from furnaces, properly stoked, was practicable (18). In 1821 Taylor and Brougham introduced a Bill into the House. It was dead at birth, for all it did was to reaffirm the right of common law actions against the owner of a smoking chimney (19).

Twenty-two years passed and in 1843 a select committee on smoke prevention was appointed at the instigation of that formidable militant for social reform, Edwin Chadwick. This committee, too, recommended that smoke from steam-raising furnaces could be prevented, but that it might interfere with the interests of manufacturers (20). Three years later came a little landmark in social history: one of the very early examples of scientific advice to government. De la Beche, a geologist, and Lyon Playfair, a chemist, conducted an enquiry as to why it was proving so difficult to control smoke (21). Their conclusion was unambiguous: that 'the emission of smoke is an unnecessary consequence of the combustion of fuel'. If furnaces to raise steam were stoked properly—an arduous operation for the stoker—the coal would be fully burnt, and smoke would be greatly reduced. But, they added, 'it is useless to expect, in the present state of our knowledge, that any law can be practically applied to the fireplaces of common houses.' Even sanctions against manufacturers were difficult to apply, for to win a case in court someone had to prove that the smoke was a nuisance; and of course action before the event was impossible: the charge had to be made in consequence of the nuisance. Moreover, it had to be proved that the nuisance had persisted, without abatement, for a whole week; this was virtually impossible. Without some specific legislation from the central government to outlaw smoke, it would remain a chronic problem. This report was followed by another attempt to bring in a timid Smoke Abatement Bill. Mill owners petitioned Parliament to have it suppressed. It was dubbed 'premature' and it sunk without trace (22)

I now come to the first of my two selected episodes. There had, since 1845, been a number of attempts in Parliament to bring in a Public Health Bill to give effect to the recommendations of a Royal Commission which had been appointed two years before. In 1848 a fresh Bill introduced by Viscount Morpeth, included sanctions against smoke. His opening speech exemplified the 'new look' in the politics of social reform: a consideration for his fellow men reminiscent of the speeches of Lord Ashley. The wealthy, he said, can choose healthy sites for their homes. If health failed them in one place, they could pursue it elsewhere. 'But for children of poverty, and toil, if legislation did not interfere to bring it to them' health would be unattainable. The Bill was chiefly concerned with better water supplies, sewerage, and drainage; but among the permissive powers proposed for local authorities was that they should 'require that certain furnaces be made to consume their own smoke.'* At the committee stage this smoke clause was attacked. There was pressure to exempt mines, brickworks, potteries, coke works and ironworks from smoke control. Enforcement, said one member, would be 'highly objectionable'; 'exceedingly injurious in the manufacture of iron', said another. But it was not denied that smoke could be abated and fuel saved provided the 'scruples and prejudices of the stoker' could be overcome. The escape clause 'if practicable' (so useful a couple of decades later to the alkali inspectorate) was added; but even this was unpopular and the clause was dropped in the Bill sent to the House of Lords. Their Lordships re-introduced it, in a slightly different form. But when the Bill went back to the Commons the clause was thrown out again, largely at the instance of the celebrated John Bright, who declared that 'he had opposed every Smoke Bill that had been introduced to the House, and he thought this clause contained all the absurdities of all the former measures put together'. The opacity of 'opaque smoke', he cavilled, depends on whether there is a black or a white cloud behind it. As to agreed plans for smoke abatement, in Lancashire (Bright was at that time an MP for Manchester) 'no three men were ever found to agree upon any effectual plan for preventing smoke' (23).

When you come to think of it, it was remarkable in 1848 that any consideration should be given to smoke at all. The great cities, London particularly, were awakening to the awful sanitary conditions of the poor. In the proud square mile of the City of London, there was no continuous water supply and the intermittent supply, to standpipes in the innumerable courtyards, was often tainted with putrescent material; families lived over the stench of cesspools '*styed* together . . . in the promiscuous intimacy of cattle' (24); thousands of homes were not connected to sewers; even decaying corpses contaminated the water that people were drinking, for the citizens persisted in burying their loved ones in the city's old cemeteries. Periodically—and it happened in 1848—cholera 'slunk into the dark unwholesome courts and alleys' (25). Over 14,000 people in London alone died from it in that year (26). No-one knew how the disease spread (it was to be another 35 years before the bacillus responsible for it was isolated). The commonly accepted hypothesis was that the infection came from foul air and the stink of decomposing matter. Like typhoid (which carried off the Prince Consort 13 years later) cholera was no respecter of rank or social status, though squalid conditions clearly put people at risk. Indeed, since the well-to-do had to spend part of their time in cities, their interest in sanitary reform was not just altruistic. It is said that one of the earliest of the pressure groups, the Health of Towns Association, had a membership which read 'like a page of Debrett' (27).

Smoke, though it was assumed that it was a danger to health, had no such dramatic impact. Its effects were silent and insidious, but not so obviously lethal as the effects from tainted water and inadequate sewage. So in the mid-nineteenth century it was natural that concern about water, drains, and the elimination of smells took precedence over concern about smoke. Besides, drainage did not threaten manufacturers so seriously as smoke abatement did.

Nevertheless, although the smoke clause was cut out of the Public Health Act of 1848, it was still open (following the pattern of the Towns Improvement Clauses Act) to local authorities to petition parliament for powers to protect their citizens against smoke, and some of them did so. Newcastle upon Tyne, for instance, was granted an Improvement Act in 1853 which required 'every Fire-place or Furnace' used for trade in its area to be 'so constructed as to consume the smoke arising from the Combustibles used' (28). The City of London secured a similar power in the City of London Sewers Act 1851 (the title indicates where preoccupation lay, and it is still the Sewers Committee which deals with air pollution in London!) (29); and, under pressure from the Court of Common Council, Palmerston in 1853 extended this power to the whole Metropolis and empowered the police to enforce the provisions against smoking furnaces (30).

In the black towns of the north the new laws had little effect. For one thing breathing coal smoke was (as one man put it) 'a second nature' to city dwellers; they were resigned to it and not inclined (since smoke meant employment) to bite the hand that fed them.* Also the local authorities—often dominated by industrialists—were slack, because it was their implicit policy to value the requirements of trade above the health of their constituents.

For a whole generation the 1853 Act (with an amendment in 1856) was the only defence against London's smoke, and it met with some modest success. It did not apply to private houses, nor to clubs or hotels, because there was no known way to improve combustion in open domestic grates and closed grates were not acceptable. Nor was it applied with any rigour to industrial furnaces. But as London grew bigger the smoke grew worse. There were severe fogs in 1873, 1880, 1882, and 1891. Each one helped to concentrate public opinion (now less anxious about cholera) on the need for a policy for smoke-abatement. But there were no mass media, no eager TV producers to bring into middle class homes vivid documentations about Britain's environment, so public opinion had to be mobilised in other ways; and a feature of the 1880s was the activity of the Smoke Abatement Committee—an ancestor of the present National Society for Clean Air—which held at South Kensington an exhibition of smoke-abatement devices and awarded prizes to the makers of those fire grates, kitchen stoves, and furnaces which passed tests for efficient combustion.

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*(London, which has often preferred to have its own legislation, was therefore specifically excluded from this 1848 bill).

* The problem, as John Simon saw clearly, was to raise the social norm of cleanliness among the common people. At the age of 74, in retirement, he recorded his impression: '. . . see with what apparent indifference our nineteenth-century England acquiesces in a daily-increasing sacrifice of daylight to dirt. There are immense masses of our population . . . who endure without revolt or struggle the extremities of general *Smoke Nuisance*; not only condoning the fact . . . that the nuisance is of painful injury to an appreciable proportion of persons, and in certain states of weather kills many of them; but further . . . accepting, as if in obedience to some natural law, that their common life shall in great part be excluded from the pure light of day . . . by an ignoble pall of unconsumed soot; and hardly murmuring, in their self-imposed eclipse, that their persons and clothing and domestic furniture are under the incessant grime of a nuisance which is essentially removable. For rich and poor alike . . . there must be sufficient refinement of taste to abhor even minor degrees of dirt, and to insist throughout on the utmost possible purity of air and water . . .'; (from English Sanitary Institutions . . . (London, 1890), p. 462ff.

The only noteworthy improvement on the 1853 and 1856 Acts came in 1891, when a fresh Public Health Act for London was put on the Statute Book. This new legislation did no more than re-enact the provisions of the Smoke Acts introduced by Palmerston, but it did make one important change: it relieved the police of the duty to control smoke (which they were not doing effectively anyway) and transferred it to the borough sanitary authorities, with a 'long stop' which empowered the LCC to act if sanitary authorities were in default (which they often were). Accordingly, the LCC instructed its coal officers to report cases of nuisance from black smoke. In the eight years between 1892 and 1904 no fewer than 9,133 cases were reported. Spurred by these reports, some sanitary authorities began to act.

This deliberate campaign to use powers which the LCC and the metropolitan boroughs had possessed since 1853 was followed by a notable decrease in the number and intensity of London fogs and an increase in sunshine:

	days with fog	*hours of bright sunshine*
winters 1883–4 to 1891–2	29·9	55·6
,, 1892–3 to 1900–1	20·7	70·1
,, 1901–2 to 1909–10	10·6	93·5

It is possible that secular changes in climate may have contributed to these trends, also the spread of gas fires in place of coal; but opinion at the time was in no doubt that they were attributable also 'to a more vigorous enforcement of the smoke prevention clauses in the Public Health Act' (31).

By the turn of the century, then, there had been some improvement, but the campaign for clean air over London was by no means won. For one thing, railway engines caused a lot of trouble (though any Londoner of my age cannot but look back on them with nostalgic affection). By burning bituminous coal instead of anthracite (which they had done since the S. Wales coal strike in 1898) the railway companies were said to have saved up to £50,000 a year. The penalty for causing a smoke nuisance was £5: a trivial price to pay for the annual saving (32).

Another perplexing problem was what to do about smoke from private houses. When industries were charged with smoke pollution it was a common defence that 95 per cent of the smoke poured into the London air came from the domestic chimneys of 700,000 houses. If Londoners could be persuaded, or obliged, to use closed stoves, as in Germany or France, the nuisance would be dispelled. But—as the Chief Officer reported to the LCC: 'The open fire is such an essential feature of our national home life that any attempt to abolish it is almost out of the question' (33).

The most frustrating difficulty, however, was the ambiguity of the Act empowering the metropolitan local authorities to control even industrial smoke. It was, as the LCC official described it, 'crippled with qualifying words'. The most exasperating of these was (as John Bright had foreseen generations earlier) the word 'black'. To proceed successfully against a smoke nuisance, it had to be proved to be black. What irked the metropolitan authorities was that they rarely got a conviction. When the Chelsea Borough Council, for instance, instituted proceedings against the Underground Electric Railways Co., there was a long trial; expert witnesses appeared for both sides; the case was dismissed with 300 guineas costs against the borough council (34).

But pressure for improvement was building up, and soon after the turn of the century the LCC stepped up its efforts to deal with smoke in London. In an episode which dragged on for nearly ten years the Council sought to strengthen its powers by means of a Bill to be put before Parliament. I shall now recount this episode, as my second example of the historical foundations which lie beneath the Beaver Report, for it is an example of how local government can lead, and not just follow, in social reform.

The prelude was in the autumn of 1900. The Meteorological Office sought aid from the LCC over an enquiry (at the initiative of the electric lighting companies) to assist the forecasting of fog. The press greeted the announcement with pleasure: 'something at last is to be done to seriously grapple with the far-famed London fog' (35). The LCC willingly co-operated, and contributed £250 to the cost of the enquiry.

A couple of years later the LCC was seeking to enlist the Royal Society in research and development on smoke abatement. The Royal Society (evidently reluctant to get itself mixed up with such a topic as the design of fire grates) referred the enquiry to the National Physical Laboratory. The reply was not very helpful. It advocated a permanent organization to collect data, to make experiments and to promote the education of public opinion. The project would cost money, which the National Physical Laboratory said it could not provide; and the LCC were asked whether they would finance a preliminary study to the tune of £500. On 21 July 1903 the LCC had to reply 'unfortunately the Council is unable this year to allocate so large a sum for this purpose' (36); so nothing was done. It is a sobering reflection on the financing of research and development that there was no means to raise £500 from a government laboratory or from the LCC to examine a nuisance which was known to be costing millions of pounds a year.

In 1904 the Chief Officer laid before the Public Control Committee of the LCC a report entitled 'Smoke Nuisance in London.' It summarized what had been done and the problems which remained, and it recommended amendments to the law which, *inter alia*, would (i) increase the penalties for which railways would be liable if their engines emitted smoke; (ii) constitute the LCC, and not the borough sanitary authorities, as the sole executive authority for dealing with smoke in London (a sensible proposal, since smoke does not confine itself to borough boundaries); and, most important of all, (iii) extend section 24b of the Public Health (London) Act 1891 (declaring a chimney, other than that of private dwelling houses, emitting black smoke to be a nuisance under the meaning of the Act) to cover all smoke, irrespective of its colour (37).

The report was discussed, referred to a committee, deferred, and ultimately, three years later, withdrawn. *The Morning Post* diagnosed the reason for this vacillation, when it stated that the issue involved a clash of two 'great principles . . . One is that an Englishman's house is his castle, and the other is that he may not use his castle so as to annoy his neighbours' (38). In January 1908 the Chief Officer produced another report, urging five measures: (i) the omission of the word 'black'; (ii) a repeal of some of the exemptions which weakened the 1891 Act, (iii) an extension of the powers and responsibilities of the LCC *vis-à-vis* the metropolitan boroughs, (iv) power to spend funds on research, and (v) education to promote smoke abatement (39). This time the draft proposals were submitted to the City of London and the 28 metropolitan boroughs. There was a mixed response: 7 wholly approved, 5 approved save for the LCC becoming the paramount authority, 6 partly approved, 6 disapproved, 4 had no opinion to offer, and one did not reply. It was a measure of the weakness of public interest in the issue. The common

Londoner was not yet ready to press his elected representatives to do much about smoke, and of course the creators of smoke constituted a powerful lobby to discourage any measures which might put them to trouble or expense. Nevertheless, the LCC pressed on and by April 1909 the Council was ready to apply to Parliament for legislation to delete the word 'black', and to tighten up the law and facilitate its operation in sundry other ways.

Resistance to the proposals was soon mobilised. The London Chamber of Commerce sent a deputation to the LCC's parliamentary committee, determined to oppose any deletion of the word 'black', for it was—they openly admitted this—'their only safeguard against more or less vexatious proceedings' (40). A representative from the pottery firm of Doultons, at Lambeth, made the thinly veiled threat that certain manufacturers 'if pressed too hardly by smoke legislation might be driven to leave London.'

This was only the beginning. When the Bill came to the House of Commons there was a move to reject it *in toto*, and other moves to strike out the clause about the deletion of the word 'black'. The Bill went to the Local Legislation Committee of the House where the supporters of the Bill were confronted by 13 petitioners objecting to various parts of it. They included the London Underground Railways, the Central London Railway, the Electric Supply Companies of London, the Gas Light and Coke Company, and the South Metropolitan Gas Company (41). (In passing, it is worth noting that not all industrialists in those days put up such a resistance to smoke-abatement measures. As long ago as 1874, in Nottingham, it was the manufacturers who induced the corporation to bring in a very stringent code of smoke control—quite the most draconian in the country (42). What was the reason for this uncommon enthusiasm of Nottingham industrialists for clean air? Not, alas, altruism, nor consideration for the people. In Nottingham the mills made lace, and lace has to be clean!). The hearings went on for 10 days. The Bill emerged from the committee at the end in a deplorably emaciated condition. An application to include Crown Properties within the smoke abatement laws (Woolwich arsenal and dockyard were a constant smoke nuisance, though this was denied) was turned down. West Ham objected to the proposal that the LCC should be able to take action outside the county boundary; so this clause was struck out. And the main amendment, which the LCC regarded as 'of cardinal importance' (43) was disallowed: the word 'black' remained on the Statute Book. All that remained of the Bill were three amendments: (i) the LCC could take action in special cases of smoke nuisance at the request of a sanitary authority; (ii) the LCC could take action against smoke pollution from a sanitary authority itself; and (iii) the LCC could spend up to £500 p.a. in investigating smoke nuisance. This veritable mouse of a Bill secured the Royal Assent in August 1910. Except in detail, the control of London smoke still remained under Acts passed in the 1850s.

Between 1910 and 1956 there were two revisions of the Public Health Act: one in 1926 which, included smoke clauses following another committee report, this time under Lord Newton's chairmanship; and another in 1936. The smoke clauses still qualified for the LCC Chief Officer's criticism of the 1891 Act: they were 'crippled with qualifying words'. But at least smoke needed no longer to be black, though if it were not black, it was a defence that the best practicable means had been used to control it. And black smoke was not defined in the Act and was difficult to prove in court. There were still exemptions (such as private houses) from control; there were permissive instead of obligatory clauses, and there were boundless opportunities to prevaricate over what constitutes a nuisance. In brief, a picnic for lawyers but the despair of conservationists. There are signs that public interest had for the time being evaporated. Thus in 1934 the sum total of annual subscriptions to the National Smoke Abatement Society from 57 local authorities amounted to £161.4.0 and the Society's total income, from industry, societies, private companies and local authorities was only £874.9.6. (44).

III

Such was the state of the law and of public opinion when the 1952 fog descended on London (45). Let us now come back to my theme. To what persons and circumstances are we indebted for the Clean Air Act of 1956?

Not at all, I said, to the Government of the day. They merely responded to public opinion. Nor was it due to some breakthrough in technology, for smokeless fuel had been on the market in quantity for a generation*, though the demand for it had from time to time exceeded the supply. Nor was it solely due to the 1952 fog, for there had been many severe fogs before. Nor solely to the Beaver Committee, for there had been many such committees before. Nor solely to Gerald Nabarro, for other enthusiastic MPs had tried to get Bills for smoke abatement through Parliament. Nor solely to the National Society for Clean Air and its forerunners; though now we are coming closer to the historical roots of the Clean Air Act: for one thing is clear about that Act, namely that the public and Parliament were prepared for it, and without the patient propaganda of voluntary societies, neither the public nor Parliament would have been prepared.

The short answer to my question is that it needed the concurrence of all these persons and circumstances to put the Clean Air Act on the statute books. For pollution abatement is more complex than most other measures of social reform.

Not only—as (for example) for the abolition of slavery—must the public conscience be aroused. The reforms must also be technologically feasible, economically acceptable, and—since pollution is a second order effect of processes which greatly benefit society—there has to be some convincing balance of cost-benefit or risk-benefit in favour of pollution abatement.

Look, in this context, at the circumstances in 1848. Cleaning smoke out of the air was not a high priority in the public mind. Fear—always a useful factor in social reform—was concentrated upon cholera, typhoid, dysentry, diseases not associated with smoke. Self-interest—another useful factor—put a higher premium on industrial growth than on social health. To clean the air offered no obvious economic advantage, and any constraint put upon an industrialist in the public interest would have been regarded as erosion of *laissez-faire*. Also the contemporary technology was insufficient to control industrial smoke conveniently, and to control domestic smoke would have imposed a new social pattern on the domestic hearth. So the efforts of reformers were resisted, and they seemed to fail. But some good came out of it nevertheless. The notion that clean air was desirable was innoculated, so

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*E.g. the following figures for production of:

	anthracite	*gas coke*	*hard coke*	*phurnacite*	(*tons* × 10^6)
1925	6·2	9·8	11·0	—	
1955	4·4	12·5	18·1	0·3	

to speak, into the public conscience. Even such weak legislation as did exist in the 1850s had—as laws do—some educational influence upon thinking men. There had been (as Simon called it) some 'refinement of taste' over the norms of cleanliness for air and water.

By 1910 the circumstances had changed, but they had not changed enough. The technology for smoke control was at hand, and feasible. The economic arguments were favourable; it was recognised that to burn coal without smoke was to save on fuel costs. But coal was cheap and the public conscience was too sluggish to support reform against the interests of industry and commerce, and the mass media then were not equipped, as they are now, to bring a public issue vividly into every home in the nation. There was no outcry when the National Physical Laboratory and the London County Council between them could not mobilise more than a paltry sum for research into smoke abatement. Moreover in 1910 we were still living in an older pattern of British social legislation. Governments were still very reluctant to intervene in the affairs of private citizens or corporations. The common response to a rising social norm was the minimum adjustment of legislation. Heroic legislation, such as the welfare state, was still a generation away. Once more the efforts of the reformers seemed to fail. But it was not wasted effort: the social conscience over clean air had been lifted another notch.

By the 1950s the circumstances had changed again. The price of coal had risen from as little as 66p per ton in the 1920s to nearly £4 a ton in the 1950s. The necessary technologies, e.g. new designs of domestic hearths, were even better developed. Government intervention had become the acceptable pattern foı social legislation. Above all, social norms had risen. The common Englishman, who now expected a level of indoor plumbing which would have been luxury for his grandfather, began to call for better conditions out of doors too: less smoke, fewer smells, cleaner rivers. So when the fog of 1952 fell on London it acted as a precipitant for a slow reaction which had gone on in British society since the 1840s. News of deaths due to fog did not seep slowly through the nation, as they would have done a century earlier; within hours of the announcement radio, television, and the popular press had reported and commented on what had happened. This was the signal for leaders of the public conscience to seize the initiative. The campaign for clean air could now be carried over the last hill.

It was the climax, you see, of a long historical drama. I have given you only a synopsis of it. In this last act, Sir Hugh Beaver played a star part. We meet today to pay respect to his memory. I have heard it called a lucky chance that Beaver was called upon to be chairman of the Committee on Air Pollution at that critical moment. A lucky chance for Britain's environment, perhaps. But Beaver's career could well be summed up in Poincaré's vivid phrase: 'Chance comes to the prepared mind.'

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Letter to the Editor

Dear Sir,

Considerable publicity is now being given to the conservation and efficient use of our energy sources. Recently it was reported that a £2 million advertising campaign was to commence and this is now evident both on television and in the press. Also it was indicated that at last, through the Department of Energy, research on alternative energy sources is to commence, although the amount of money being made available is limited.

In addition, standards of thermal insulation in new premises are now to be increased and the Department of the Environment Circular 160/74 issued in November 1974 (Housing Act 1974, Improvement of Older Housing), appendix A, referring to Section 61 of the Housing Act, specifies that the standard of dwellings improved or provided by conversion with the aid of improvement grants shall conform with specifications applicable to the thermal insulation of roof spaces laid down in Part F of the Building Regulations in force on the date of grant approval. The second amendment to the 1972 Building Regulations, which came into force on 31st January 1975, almost doubles roof insulation values and now takes openings into account when considering the thermal insulation value of walls.

About the same time, on 23rd December 1974, six Government departments, including the Department of the Environment, issued their joint circular on Rate Fund Expenditure and Rate Calls in 1975/76 in which they gave guidance on measures local authorities could adopt to limit growth of expenditure to a level which was in line with the national economic conditions recently outlined in the Chancellor's Budget speech. Section 39 of the circular stated "the Government expects that for the year ahead local authorities may not be able to undertake any more development in the field of smoke control". This suggests that local authorities would have to suspend or, at least, considerably slow down their smoke control programmes—not the first time that smoke control has had to be suspended. Members, I am sure, are aware that some local authorities need little encouragement to suspend such programmes.

Official departments and organisations seem to me to have been remarkably slow in pointing out the very considerable saving in energy and cost that could result if, instead of slowing down, smoke control programmes were accelerated. When one compares the efficiency of the older type of open fire, burning coal with 75% of its heat disappearing up the chimney, with that of a properly installed modern appliance burning solid smokeless fuel it becomes apparent that, with coal costing at present about £1·30 per cwt it is extremely wasteful to lose in the region of £1 for every cwt of coal consumed. In addition to the lost energy, we are also wasting the very valuable by-products from which we obtain so many of our day-to-day requirements. When one adds all this to the cost of air pollution which, at the last estimate, was running at £1,190 million per year, I submit that the time has arrived to look for a quicker and cheaper method of bringing about smoke control over the whole country with the resultant benefit not only of virtually eliminating domestic smoke but also obtaining the saving in energy from what is now one of our most valuable mineral resources.

As an officer with a local authority which has only recently commenced its Smoke Control Programme, I am aware that I may be thought presumptuous in suggesting that changes may now be required in smoke control area procedure which, after all, has not changed a great deal since the early days after the 1956 Clean Air Act. But arriving on the scene only now enables one to look at the problem without the handicap of having had to operate when prevailing circumstances were somewhat different and, like Blucher at Waterloo when the smoke of battle has, to some extent, thinned, a clearer view over the whole field can be gained and a more effective line of attack becomes apparent. It is true that in local government most changes have, in the past, come extremely slowly, but as more and more officers undergo management training courses one sees the advantage of the constant reappraisal of projects to avoid the common pitfall of carrying out a job in a particular way because that is the way in which it has always been carried out.

At the same time, I would take this opportunity of explaining how grateful I am for the considerable assistance given to me by colleagues in other authorities, many of whom have had extensive experience in smoke control procedure over the last few years.

In considering changes that may be required, I am particularly interested in the anomalies that arise when occupiers are given virtually complete freedom of choice of fuel. This I believe resulted from the situation which existed when the supply of cheaper gas coke reduced and it was considered that applicants should not be forced to burn the solid premium fuels which at that time were relatively scarce and much more expensive. Today, of course, gas coke is unobtainable in many areas, only hard coke being available with a price difference of only a few pence when compared with the reactive open fire fuels. In many of the dwellings in our first two smoke control areas it has been found that residents have been burning reactive fuels even in ordinary stool-bottom grates and fret fireplaces without any difficulty other than a loss of efficiency due to the improper air supply control. Why, therefore, should occupiers of such premises be entitled, as of right, to change to another type of fuel and appliance at some cost to the rate-payer and tax-payer? For those who would argue that there is an insufficient source of supply of the solid smokeless fuels, I would say that recent enquiries from the Solid Smokeless Fuels Federation revealed that they could now meet expected increases in demand. Merely changing from a stool-bottom grate and fret burning coal to an approved open fire burning solid smokeless fuel gives an increased efficiency of some 12½ per cent and when a back boiler unit is also installed this efficiency increases by about 37½ per cent. At least then the situation would not arise where, in the case of two identical houses, one fitted with a stool-bottom grate and fret, whilst its neighbour is fitted with an approved open fire, we would have to pay grant in the first case for the replacement of the older-type fire with an approved appliance whilst next door we would remove perhaps an identical approved appliance and replace it with a fire using gas or electricity as a fuel. I do not feel that changes in this direction would involve any great administrative difficulties. It was, for instance, fairly straightforward to change circumstances when gas coke was no longer available.

Perhaps officers who have had more experience in smoke control work than I may like to take the opportunity of expressing their views on this topic.

Yours faithfully,

L. H. Whanslaw
Senior Health Inspector
(Air Pollution & Noise Control Section)
Brighton District Council

Report of the Bristol and District Environmental Pollution Technical Committee

Summary

(*i*) *The area surrounding the Avonmouth and Severnside Industrial complex has been extensively monitored for the presence of heavy metals and other pollutants by a variety of organisations working independently of each other and using a wide range of methods.*

(*ii*) *The results of the monitoring have indicated that no medically unacceptable burden of these metals is being inflicted on the local population, according to standards currently accepted in this field.*

(*iii*) *There is a need for continuing vigilance to ensure that:*
  (*a*) *the most accurate information on levels of all potentially hazardous pollutants, together with relevant meteorological data is available to the authorities responsible for pollution control.*
  (*b*) *the current state of affairs is not allowed to deteriorate and where-ever possible is improved.*
  (*c*) *The most effective methods of pollution control and monitoring made available through advancing technology are applied.*

1. The Committee was originally constituted by the former Bristol County Borough Council to investigate air pollution problems at Avonmouth, and to support this and to provide detailed technical information, a Working Party was formed consisting of medical, scientific, veterinary and technical personnel with a professional and academic interest in the environment. The opportunity is provided for the multi-disciplinary assessment of the methods used in monitoring and the results obtained, and forward planning is assisted by the continuous critical examination of the achievements and objectives of the various member bodies.

2. The organisations contributing to the Committee are as follows:

City Council of Bristol, Environmental Health Department.
City Council of Bristol's Veterinary Adviser.
Avon Area Health Authority, District Community Physician (formerly Medical Officer of Health, Bristol County Borough Council).
Avon County Council, Public Analyst and Chief Scientific Adviser (formerly Public Analyst and Adviser, Bristol County Borough Council).
H.M. Alkali and Clean Air Inspectorate.
Commonwealth Smelting Limited.
Department of Health and Social Security.
Department of Trade and Industry, Warren Spring Laboratory.
Ministry of Agriculture, Fisheries and Food.
University of Bristol.

3. Because of the concern over heavy metal pollution and the presence of non-ferrous smelting industry in the area, the Committee has so far directed much of its attention to the monitoring of heavy metals, both from the public health and ecological viewpoints.

4. The monitoring methods used have included the following:

Blood lead survey in human population.
Blood, tissue and faecal samples from animals.
British Standard Deposit Gauges.
Continuous air sampling.
Drinking water analysis.
Examination of environmental dusts.
Grassland surveys.
Milk sampling.
Rhine water analysis.
Sampling of waste gases discharged from chimneys.
Soil sampling.
Vegetation surveys.

5. At this stage it is felt important to examine the work so far carried out, to report on conclusions which may be drawn, and to look to the future. Much of the work so far has been of an exploratory nature, and it is only by a critical evaluation that the most useful and relevant action can be chosen for the future.

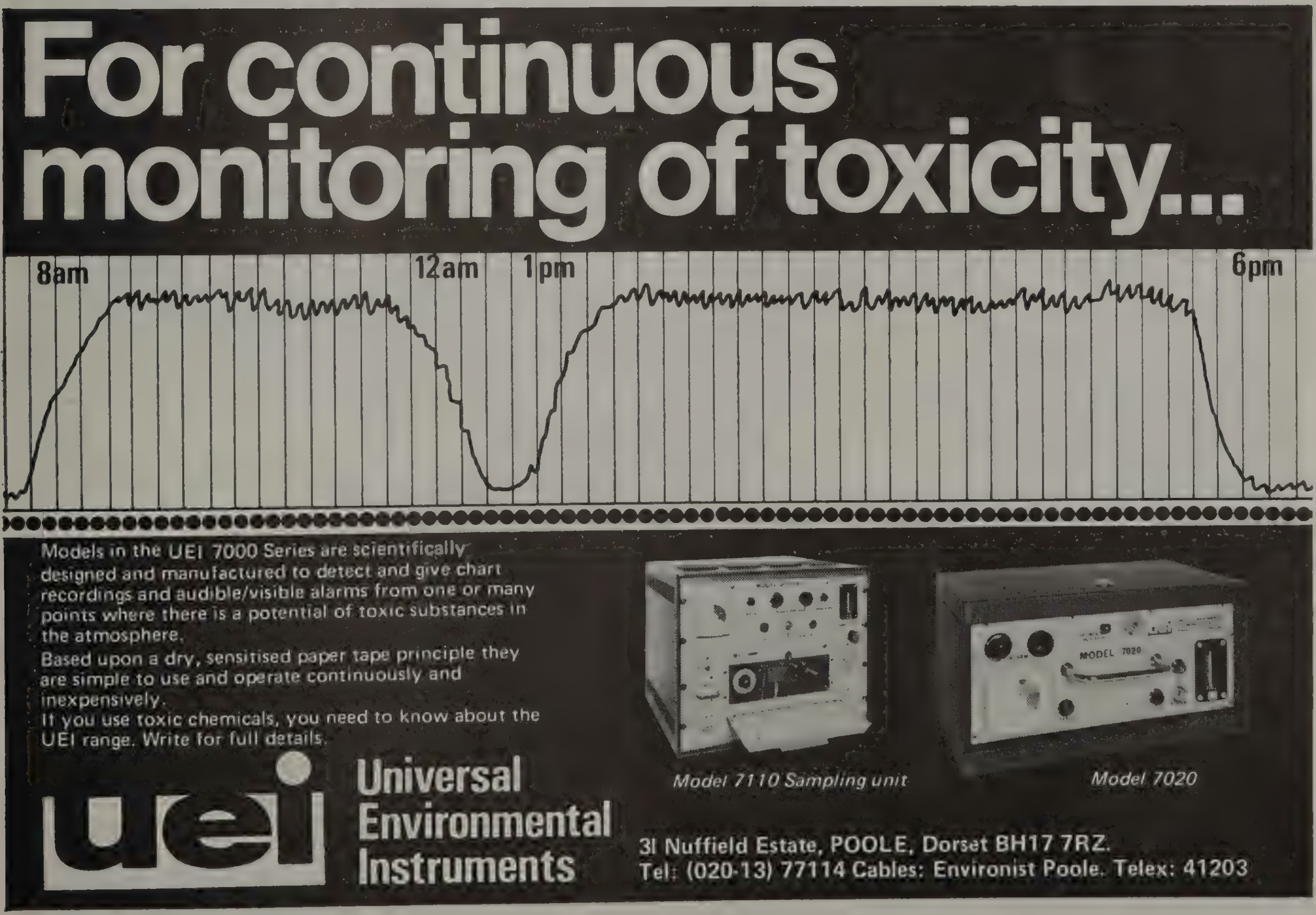
6. As anticipated in the vicinity of a non-ferrous metal smelter, some levels of lead, zinc and cadmium are above those which would be normally expected in a non-industrial area. The mean lead levels in the blood and faeces of cattle in the area have been demonstrated to be raised, although no clinical symptoms of poisoning have been seen and the intake has been found to fall rapidly with increasing distance from the source. The analysis of milk samples from cows grazing on pasture land in this area have been of the same order as those from cows grazed in North Gloucestershire. Two surveys of lead levels in the human population in Bristol have been carried out. In the first, larger survey, carried out in 1972, lead levels in over 1000 children in Bristol were examined including 130 lead workers' children. Levels of lead in the blood of these children showed no difference between those living in the North West area of Bristol as compared with those living elsewhere. The lead levels in lead workers' children were found to be slightly raised in comparison with others but there was no evidence of any harmful effects. A more recent report, Survey (1974) comparing 87 lead workers' children with 64 others has confirmed the latter findings.

7. Since the area is well monitored for smoke and sulphur dioxide by the National Survey method, and on that basis is broadly comparable with other areas of Bristol and compares favourably with many industrial regions in the country, the opportunity has been taken to examine the samples so obtained for heavy metal content. The results demonstrate some increase in lead, zinc and cadmium concentrations, bearing in mind that the apparatus was not specifically designed for this application and these results only follow as secondary information. Much more reliance is placed on continuous air samplers as used by Commonwealth Smelting Ltd., and the former Public Analyst and Scientific Adviser's Department of the Bristol County Borough Council. The average monthly levels for lead and cadmium found by the two organisations working independently are broadly comparable, having regard to the different locations used for sampling.

8. The examples quoted confirm what would be suspected by ordinary deduction, i.e. that the presence of a large non-ferrous smelting complex is reflected in the results of environmental monitoring in the surrounding district. Other examinations, such as rhine water analysis fail to show any significance in this respect and the survey of locally grown vegetables, prepared in the normal manner for cooking, has not demonstrated levels which would adversely affect the consumers. Surface contamination of leaf vegetables by air-borne lead may be reduced ten to thirty fold by washing and discarding the outer leaves. The importance of proper preparation of vegetables, therefore, cannot be over emphasised.

9. The most consistent conclusion drawn from the data amassed is that with the closure of some of the older plant in 1971/72 together with other improvements made by the Company the levels of heavy metals detected in the environment have decreased. It is also found that the deposition of heavy metals shows a fall-off with distance from known emission sources.

10. It is the Committee's view that a wide margin of safety exists for the human population in their exposure to heavy metal pollution in this area according to the current state of scientific knowledge, and although the lead intake of animals in the area has been demonstrated to be unusually high, no clinical symptoms or illness in the animal population have been observed. We wish to maintain and wherever possible improve the current state of affairs, hence the need for a continuing programme of monitoring using the most relevant and informative methods matched to the increasing knowledge which is being gained of the nature and effects of pollution.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Clean Air in the Streets

by

J. D. Davis

Amongst the many consequences of the recent massive increase in oil prices, an extension in the use of diesel engines for road transport use is a certainty. In Britain, as in many other European countries, this will mean further penetration into the light delivery vehicle market, as well as some inroads into the passenger car sector. Although it may be a long time before the majority of new private cars are diesel powered, it must be remembered that a considerable proportion of new cars are still purchased by companies for business use. Many company cars accumulate between 20,000 miles and 50,000 miles each year and the choice of a diesel engine will be difficult to avoid when it is realised that fuel cost savings alone will be in excess of £100 per annum for each car and the higher initial cost will be recovered in a matter of months rather than years. The more widespread use of this type of engine will not only be seen on main roads but there will also be a marked effect on urban traffic.

The diesel engine is often presented as more socially desirable than the petrol engine because of its lower fuel consumption, and exhaust emissions which are lead-free and very low in carbon monoxide and unburnt hydrocarbon content. To these advantages can be added reliability and long life. Quite apart from the benefits mentioned above there are undoubted environmental gains to be obtained providing noise can be suppressed and the exhaust maintained in something like the condition prevailing when the engine is new. Unfortunately these high hopes of cleaner air in the streets and on the highway are not yet sufficiently borne out by our everyday experience. Indeed opinion research carried out about the time of the first Clean Air Act showed that diesel exhaust emission was "public enemy number one" and in the public mind was a greater nuisance even than the smoke and soot from domestic coal fires. Despite this finding much greater attention has been paid to cleaning up petrol engine exhausts. When politics are involved public opinion is not always the determining factor.

In the past two decades the British diesel vehicle population has increased greatly. While, with the pressure of time, there has been a welcome reduction in the frequency of dense smoke emission from heavy vehicles, which are the principal offenders, the reduction in the average level of smoke does not appear to have kept pace with the population increase. Consequently our streets seem not to be enjoying the hoped for reduction in diesel smoke pollution. Doubtless the situation would have been worse had not substantial engine improvements been made. However, there can be little doubt that many motorists, and even more pedestrians, are still dissatisfied with the present state of affairs, and so far as I can judge the situation is liable to get worse rather than better.

There are three main reasons for this somewhat pessimistic contension. The first depends on the fact that low diesel exhaust emissions depend primarily upon a high quality of maintenance and driving. So long as the diesel is limited to large transport fleets the possibility of maintaining high standards is good; but as its use becomes more widespread it is very likely that average standards of both will fall with a consequent worsening of exhaust pollution. Second, with an increasing demand for diesel oil and a relative decline in the use of gasoline, changes in the boiling range of diesel oil may be made which could adversely affect smoking characteristics. Third, since there is an increasing pressure to reduce engine noise, designers will want to retard injection timing as one of several options available, and such a change would tend adversely to affect exhaust smoke. It would indeed be unfortunate if noise reduction measures were to result in increases in exhaust smoke emissions and it is to be hoped that engine designers will use instead the other means of noise suppression that are available to them. With these three things in mind, combined with the prospect of increasing numbers many of which will be operated by small companies or individuals, one cannot be optimistic about the likely trend of events. Unless deliberate action is taken soon to protect public amenity in towns and on the open highway a deterioration in air condition is likely. It is the purpose of this brief article first to identify a worsening problem and second to review some possibilities which could help to ameliorate it.

One of the principal objectives of an engine designer is to obtain as much power as possible consistent with the acceptable performance of the engine in other respects. In a diesel engine his aim is to arrange combustion in such a way as to consume as much of the air as possible without producing a smoky exhaust condition. Consequently the engineer will always work up to the acceptable limit of smoke emission and the process of normal engine development produces improvements in power output per litre but not an improvement in exhaust cleanliness. This situation can only be modified if external constraints are introduced which specify a maximum power setting well below the level of exhaust smoke emissions. In other words, since the problem of diesel smoke in service does not relate to new engines but to ones which have deteriorated in use, an effective constraint on the engine builder would require the de-rating of engines at the factory in order to provide the necessary margin for deterioration in service. If offensive exhaust smoke is to be avoided in say 95 per cent of vehicles a very substantial margin would have to be provided. A margin allowing for average service deterioration would be quite inadequate.

One way of dealing with the problem is to rely entirely upon standards with which the engine builder must comply. There is no reason of principle why stringent standards requiring smoke free operation over a normal overhaul period of say 50,000 miles in not less than 95 per cent of vehicles should not be introduced over the next few years and become an effective control for vehicles which are yet to be brought into service. Federal standards of this type, which apply to new vehicles only, are already in use in the USA and during the past year or two have been made substantially more severe. The following tabulation (Table 1) shows a comparison of standards applicable in 1973 and 1974 to vehicles of more than 6,000 lbs gross weight.

Federal Smoke Emission Standards for New Diesel Engines

1973	1974
Opacity shall not exceed: 40% during acceleration mode 20% during lugging mode	Opacity shall not exceed: 20% during acceleration mode 15% during lugging mode 50% during peaks in either mode
Measurements at: 0, 125, 250, 375 . . . 1000 hours	Measurements at: 0, 125, 250, 375 . . . 1000 hours

Table 1

Exhaust capacity measurements are made in controlled engine dynamometer type tests in which exhaust condition is checked every 125 hours over a total period of 1,000 hours. The standard has been strengthened in two respects. Firstly the smoke density has been reduced in both the accelerating and lugging modes and secondly a limit on peak emissions in either mode has been introduced in 1974. A requirement to eliminate transient peaks could be a serious problem for some engine builders. The main shortcoming of this type of control is that it has no influence on the smoke characteristics of the very large existing diesel vehicle population. While there is likely to be interminable discussion among engineers about the optimum test conditions and the levels to be used for exhaust emission control, there is much to commend this approach and over a period of a decade, during which the existing vehicle population will be replaced, it will increasingly provide a necessary regulation of air quality at street level. It is therefore a matter of some urgency that stringent controls of this type should be introduced in this country where diesel use is already much more widespread than in the USA. Furthermore it is necessary that they should apply to vehicles of all sizes and weights and not only to large transport vehicles.

Diesel vehicle manufacturers in this and other European countries already comply with national regulations on such things as noise, smoke, axle loading and power weight ration, also the first EEC directive concerning road vehicles fitted with diesel engines came into force at the beginning of 1974. This latter is designed to reduce smoke emissions and sets capacity limits for a stable engine speed test and a free acceleration test. The importance of this EEC standard derives from the fact that no member state can refuse approval to a vehicle satisfying the Community directive because its exhaust emission characteristics do not comply with national requirements. At the time of writing the Commission do not appear to have plans for any new initiative of their own with regard to diesel engine emissions but they wish to monitor changes in national standards and comment upon them at the draft stage. Further improvements in European countries in the immediate future consequently depend upon national initiatives.

In addition to the conditions laid down in the current British Standard (BS AU141A) which applies to engines in the new condition and regulates the engine designer and builder, there is also legislation empowering the police to take action on any vehicle thought to be emitting excessive smoke in service. Although this law is enforced from time to time in the case of some serious offenders it is obviously completely impractical to expect an already overworked police force to do much more than they are at present. Furthermore, since the objective must be not only to eliminate the grossest offenders but also to ensure that only a very small proportion of the diesel vehicle population emit any visible smoke, the task is beyond the capabilities of any police operation. The efforts of the police are reinforced by spot-checks carried out by Department of the Environment inspectors. Although these amount to about 30,000 each year, and bearing in mind that there are millions of vehicles on the road each day, they cannot have a very big direct effect on the elimination of smoking vehicles, but they do have an additional beneficial deterrent effect because operators do not like to lose money as a result of their vehicles being ordered out of service after inspection. The existing law is valuable in limiting the number of seriously dangerous dense smoke emitters, but it does not and cannot do anything significant to maintain a "smoke-free' diesel vehicle population.

The short term problem, therefore, must be to provide means which can be applied to the existing vehicle population that will ensure that they are serviced as often as may be necessary to restore their smoke emission characteristic to the "new-engine" condition. Having stated that police action must be ruled out for the mass of slight and moderate smokers, there are three other options which deserve serious consideration. The first would not involve any legislation and would depend upon fleet operators becoming convinced that it would financially pay them to adopt "engine-health monitoring" systems. Some large fleet operators have experimented with such systems and there is a growing conviction that the initial capital and operating costs involved are small compared with potential savings in vehicle maintenance costs and the losses involved in unscheduled interruptions in vehicle availability caused by unexpected faults. The growing importance of maintenance and repair costs can be appreciated when it is realised that they now represent up to 25% of the total operating cost of a large vehicle, compared with 15% a few years ago. The experience of BP oil delivery vehicles in Denmark was described by D. E. Matthews in a paper to the Institution of Mechanical Engineers' Conference on "The reliability of Diesel Engines and its impact on cost" which took place in November 1972. Although exhaust smoke monitoring was not included in these fleet trials it would appear that its inclusion in a "health-monitoring" system would not greatly add to the total cost and could be an effective way of ensuring that early preventive maintenance took place to avoid further deterioration in engine condition and consequent higher levels of smoke. There are two shortcomings to this approach to the problem. First, it will be slow to become widely adopted and second, the small operator, who frequently is the worst offender would be the last to be influenced and indeed may never take voluntary action of this sort. Since urgency must be the keynote in dealing with existing vehicles "health-monitoring" can perhaps only play a small part.

Both of the two other approaches would require new legislation, which would need to be enacted in the next year or two if it were to be most effective. The first would require the fitting of an automatic smoke controller and would involve a fairly costly addition to all existing engines. This would consist of a smoke sensor in the exhaust system, signals from which would be used in a feedback to the fuel pump, so that the appearance of a smoky exhaust would automatically result in a reduced fuel flow and elimination of smoke. One can be reasonably confident that such a device would be technically feasible. Until recent years it would have been impossible to find a reliable smoke sensor, but today there are at least two types which might be used. Optical devices, originally developed in the USA for space work, are now available for more mundane use. The Celesco system would be an obvious candidate and various models are currently marketed in the UK for industrial applications. Another approach to the problem is to be found in a sensor which detects the static electricity charges which are present on smoke particles. Further development work will be required to produce reliable automatic smoke control systems no matter what the type of sensor may be. It is most unlikely that such work will be financed unless there is a definite commitment by the Government to make the use of such devices obligatory. In principle this approach to the problem of diesel vehicle smoke emission is attractive because of the positive way that it would remove offending vehicles from service immediately the exhaust becomes offensive and it would do so without the intervention of the police. There are, however, two considerations which would require close investigation. Like any device it would be open to interference and in order to ensure that it was kept in operation, arrangements would have to be made so that the engine would not run unless the smoke-controller was functioning. Because of this an electrical or mechanical failure of the system would result in a total vehicle breakdown. One might reasonably question whether it would be wise to introduce such a positive control which itself could take a vehicle out of service that was not emitting smoke. Another consideration is safety. The instantaneous effect of the device would be to reduce the fuel supply so that no smoke was emitted. In some cases, for example when overtaking another vehicle, this could prove dangerous, since the driver would start the manoeuvre believing that a full power acceleration was possible and would only discover that such was not the case when he was already well committed to the manoeuvre.

An alternative approach, which would also require legislation and would use the same sort of sensors as those described above, would avoid the problems associated with a positive automatic electro/mechanical controller system. In this case the sensor would be coupled to a recording instrument. The legal requirement would have two aspects:

(a) all diesel vehicle operators would have to keep approved instrument records of exhaust condition and return them at regular intervals to the authorities for inspection (a standard instrument record could be automatically inspected by machine);

(b) operators would be required to submit their vehicles to official test centres and maintenance as soon as the instrument record indicated that a prescribed smoke standard was being exceeded. A certificate of official inspection and corrective action would accompany the instrument records when they are returned to the authorities for inspection.

Failure on the part of an operator to meet his obligation to have a smoky vehicle inspected and serviced would be detected when regular record inspection took place and a penalty would then be applied in much the same way as parking offences are now dealt with. There would seem to be much to commend this type of legislative approach, particularly as it places the main onus of responsibility for corrective action upon the operator and involves a minimum of interference by the authorities. Furthermore it is likely to be a relatively inexpensive instrument installation which could usefully be incorporated as one element in a "health monitoring" instrument package. Another potentially important advantage is that the nature and level of the control standard could easily be changed and if desired different standards set for each type of vehicle. It would be possible, for example, to include or exclude momentary emissions and it would be just as easy to specify that a vehicle should not emit more than a specified amount during a prescribed period of operation as it would to limit a transient emission of smoke. One could also envisage a monitoring system such as this having continuing value even when the whole vehicle population has been replaced by models which have passed the severe 1,000-hour type test described earlier in this article.

The first British Clean Air Act and subsequent air quality legislation has set a standard for the rest of the world as a sensible and practical approach to improvement of the environment. By somewhat slavishly following other countries in giving priority to petrol engine emissions we have paid too little attention to diesel smoke which is undoubtedly now the most offensive atmospheric problem. Although the efforts of diesel engineers and police action have helped contain the situation in a period of considerable increase in diesel population, further improvement in the next decade will require the introduction of new legislation and the development of systems to make the legislation effective. The development work required is dependant upon a prior commitment for legislation and in the present political and economic climate it is necessary for considerable public pressure to be put upon the Government if anything worthwhile is to be achieved. The National Society for Clean Air has a notable record of success in this role and it could once again be instrumental in a further major advance in air quality if it were to exercise its influence on the diesel problem.

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BOOK REVIEWS

Models for Environmental Pollution Control,
edited by Rolf A. Deininger. Pp 448 + xi. Ann Arbor Science Publishers Inc.

This collection of papers is the result of the efforts of a large number of authors to apply the techniques of systems analysis to a wide range of pollution problems.. Although only three of the 21 papers are directly concerned with air pollution, most of the other chapters are of some interest to the air pollution specialist provided he is prepared to swallow the assumptions on which the whole book is based.

The approach adopted by almost all the authors is to construct a mathematical model of the air/water/land/noise environment under consideration and solve the resulting equations, subject to certain constraints, using the results as an aid in planning. Some advocate finding the optimal policy by formal mathematics, but in all but the very simplest problems (e.g. refuse vehicle routing) this is a gargantuan task for even the most powerful computer. Even if technically feasible, it usually involves converting all costs and benefits into a common currency, to give an overall indicator which is to be optimised, and these conversion factors require human judgments which make a nonsense of the ultra-rational optimisation procedure. Many of the authors therefore simply use their models to evaluate a small number of alternative policies, a more reasonable aim which is well exemplified in the survey of air pollution control models by Burton *et al.* of the Environmental Protection Agency. They quote costs for four different control policies side-by-side with the resulting air pollution concentrations, but two of these policies themselves necessitate a considerable optimisation calculation since they require finding the least expensive way of meeting a specified air quality standard. In one example, this meant finding the best combination for 678 sources each capable of four different emission rates, which coupled with a dispersion matrix relating concentrations to emissions amounts to a formidable computational exercise. And when you have done it you still have to put it into effect, which requires a legal and administrative framework which permits different degrees of control at each source. It is difficult to imagine the formal optimum ever being achieved in real life and the costs of running such a scheme might well outweigh the benefits.

There is a very interesting paper by H. G. Fortak in which a scheme for calculating air pollution concentrations as a function of time and space using a spectral approach is outlined. However, this is again a massive computational problem in practice, so the example shown is of a steady state model using past weather records—a familiar enough concept. A frequency histogram for different ground level concentrations is calculated and compares well with measurements.

One is left with a feeling of "is it all worthwhile?". The impression given by many of the papers is that the optimum is a pretty flat one anyway, so it doesn't matter all that much if we don't reach it so long as we are not too far off. The extra effort involved in getting that last little bit of benefit seems hardly worthwhile. One author stated, as if it were something to be proud of, that the work he had described involved "eight research teams with about 25 engineers, economists, hydrologists, geographers, sociologists, civil servants and managers". Perhaps if the cost of finding the optimum were included in the calculations, the resulting optimal policy would be very different!

But the essential flaw is that the data do not and cannot support such a sophisticated analysis. We do not know all the possible effects of pollutants because the mechanisms are too complex (e.g. synergism, or the food chain problem, neither of which could have been discovered by this sort of analysis, but only by basic scientific research or bitter experience). And changes in industial technology or the resources situation may change the rules in a time which is very short compared with the life time of major planning commitments.

R. A. Cox

Problems of the Environment
by Peter F. Brooke. Published by Harrap, London.

Two chapters of this book are of special interest to readers of this Journal. The "Abused Essential" dealing with the problems of Air Pollution is the first. The Author deals with the subject comprehensively and illustrates his points with some good graphs (unfortunately a little out of date now). Some pollutants, hydrogen sulphide, nitrogen dioxide and hydrogen fluoride are however only touched upon. Exporting Pollution to Scandinavia and Importing Pollution from the Sahara is discussed as is the research now being carried out by the E.E.C. on this phenomenon. Pollution by vehicle exhausts is given fair detail as is the controversial problem of lead in petrol. Pollution in Los Angeles and the steps taken in California and in this country to control vehicle pollution are enumerated. Aircraft Pollution is included and the effects of Climate, and there is a graph giving a Trend of winter sunshine from 1939 to 1970. Methods of measurement only receive one paragraph but the effects of air pollution on Animal Health, on plants and on buildings are discussed in reasonable depth.

The second chapter of particular interest to readers deals with the problem of noise. The Author describes in easy terms the range of noise and the necessity for decibal scales. Noise from vehicles comes in for some criticism and the poor standards now set. Methods to reduce noise at airports, railways and industrial premises are given. This is a chapter full of detail which has to cover the whole subject in 20 pages and is necessarily sketchy.

The other chapters are easily read, and cover the whole field of the environment, housing, river pollution, waste disposal, food contamination, food packaging, man and his pests (including starlings and pigeons) and the problems at work.

The Author has included a very good Index and a Directory of Associations interested in the various aspects of the environment and each chapter concludes with a list of questions for class or individual work. A book of special interest to Environmentalists and especially to Students of Environmental Health needing an overall picture.

A. W. Perry

Health Guide to BP Petroleum Products

Published by BP Trading Company 50p.

The Industrial Division of BP Marketing Ltd is making available to industry a booklet which gives guidance on the possible hazards which may arise from the use of petroleum products. It has been compiled by the Occupational Health Unit of BP's Medical Department in conjunction with the Marketing Department.

BP's Occupational Health Unit is a specialist group concerned with health protection and preventive medicine in relation to the world-wide operation of the BP group. It is based at the BP Research Centre at Sunbury-on-Thames. One of its fields is the provision of advice on the safe handling of industrial materials, including oil and chemical products, and the guide is an example of this type of service.

As the booklet points out, petroleum products are not dangerous when used sensibly and for their intended purpose, but accidents or gross misuse may give rise to various health hazards and these are described, together with the remedial action which should be taken if they occur. In its introduction the guide gives general information on toxicity, types of exposure, and preventive measures. It goes on to group petroleum products into 13 categories, and describes the health aspects and emergency treatment relevant to each. Information on particular BP products can be obtained by quick reference to a pull-out index.

This is an excellent booklet which every user of petroleum products should have. Most people are sensible in the way they handle such products, but familiarity does breed contempt; people do become careless and unfortunately accidents can and do occur. The booklet is very well laid out for easy reference and BP are to be commended.

The booklet is obtainable from BP Marketing Ltd., Room 986, PO Box 148, Strand, London WC2, at a price of 50p, including postage, which should be enclosed with the order.

Extraction of Minerals and Energy: Today's Dilemmas

by Raul A. Deju: January 1974. Ann Arbor Science Publishers Inc., Michigan, U.S.A.

Many of today's dilemmas have come because mankind needs abundant water, energy supplies and mineral resources, and simultaneously minimum pollution of air, water and soil. Before the present energy hullabaloo got going and all of us became exposed to the energy crisis, Dr. Raul A. Deju initiated, in September 1972, with support from the Geological Society of America and the Society of Mining Engineers, plans to hold an "International Workshop" which we would call a technical conference or symposium. This book is one of the products of that June 10-13, 1973, "International Workshop, Environmental Problems of the Extractive Industries" held at Wright State University in Dayton, Ohio, where the author is Associate Professor of Geology. As the co-ordinator of that "Workshop", Deju has written the Preface and the Introductions to the five sections of the book. These report the contributions of 21 authors, 11 of whom came from places in Ohio, four from relatively nearby States and others from four States in the far west and south. They deal informatively in a well qualified manner with Resources, Water Pollution, Air Pollution, Resources out of Place and Social Factors, subjects so intertwined that each affects the others.

It is Section 3—"Air Pollution"—that will most interest members of the National Society for Clean Air. Its three papers deal with Control of Sulphur Dioxide Emissions, Enforcement of Air Quality Standards, and Models for Control of Global Atmospheric Composition. They were written respectively by John W. Tieman, Ronald J. Ganin and Bryan Gregor.

The U.S.A. federal laws covering air pollution started with the 1955 Air Pollution Control Act and clamour for information on commercially available control techniques to remove sulphur from fossil fuels has increased rapidly.As in his previous papers, Tieman has been most usefully informative. He has summarised in a three-page table the full-scale systems installed since 1970 in large, modern electricity generating plants in the U.S.A. for the removal of sulphur dioxide. One system uses dry additive injection, 20 use lime/limestone scrubbing, two use sodium-base scrubbing, three use magnesium oxide scrubbing and one uses catalytic oxidation.

No less than 21 other processes are also described, most of them being only small pilot plants or of demonstration size. Serious reservations exist as regards their availability and reliability around the clock. We have still to learn their ability to resist scaling, erosion, corrosion and their waste disposal problems when scaled up to large commercial sizes.

Problems of environmental damage and dwindling natural resources face all peoples, it is therefore a valuable achievement to have produced this nicely bound book just when the subjects it deals with have suddenly been recognised as being of worldwide topical importance.

T. H. Turner

The Greater London Council—Scientific Branch Director General's Department Annual Report of the Scientific Advisor, 1973

Published by the G.L.C. Price £4·25.

As ever, the Annual Report of the Scientific Advisor provides extremely interesting, if not exciting, reading and one never ceases to wonder at the large number of topics covered. As the introduction to the Report states "It would be difficult to give any order of importance to the various topics dealt with during the year. Nevertheless, three matters do stand out, at least in part, because of the attention they attract. They are the thermal insulation of buildings, the performance of materials in the event of fire, and the testing of products in relation to the conditions which will be encountered in day-to-day use." We are in no position to challenge this particular choice of topics and would certainly agree that the thermal installation of buildings is a subject with which the readers of this journal should be very much concerned. But although such readers should also be concerned to some extent with the performance of materials in the event of fire and the testing of products, possibly more of our readers will be concerned with those sections of the Report which deal with air pollution, with noise and water pollution control.

In fact by far the largest single section of the Report is devoted to water pollution control and it is interesting to speculate whether this is so because on the 1st April 1974, all water pollution functions then vested in the G.L.C. passed to the Thames Water Authority, and that this therefore might be the last Report in such a form. At the time the Report was written, the G.L.C. was responsible for administering the rivers (Prevention of Pollution) (Acts 1951 and 1961) in what is known as the London Excluded Area. This included all the tributaries to the tidal part of the Thames below Teddington Weir which were excluded from the jurisdiction of any other River Authority or Catchment Board. The area was bounded on the south and west by the Thames Conservancy, on the north by the Lee Conservancy Catchment Board and to the east by the Kent and Essex River Authorities. The total length of the rivers under control was 304 km or some 190 miles.

Quarterly surveys were conducted on all the rivers under control except for two, which were examined monthly. Every two weeks snap samples were taken on the tributaries to enable effective oxygen loads to the Thames to be determined. Factory and sewage works discharges were sampled monthly and the Report considers that their quality was "reasonably satisfactory".

This review is being written at a time when we are beginning to wonder whether it will ever stop raining; it is therefore significant to realise that the flow over Teddington Weir, the period covered by the Report, was only 33 per cent of the ten year average. The mean yearly flow for 1973 was 62 per cent less than in 1972 and 67 per cent less than the corresponding ten year average.

This section of the Report contains numerous tables and graphs which convey a very thorough picture of the state of all water courses under the G.L.C.'s control.

Quite a large section of the Report deals with sewage treatment and not only gives the general description and special features of the G.L.C. works but also compares their various performances. It is only when one reads a Report such as this, that there is a realisation of how important this service to the community is.

The section of the Report dealing with noise, after a consideration of recent legislation, states that the number of noise measurements carried out rose considerably in recent years with a particularly sharp increase in 1973 as a result of the introduction of new legislation. "In addition, there has been a marked trend towards longer term measurements and to a requirement for more detailed information on the noise climate at specific locations." These changes in turn led to a review of the measuring techniques used and the gradual introduction of new methods of measurement. These are described in some detail.

The Environmental Sciences Group has provided advice to architects, planners and engineers on those aspects of their projects that are affected by noise or acoustics, although in general, the advisory service is more concerned with the siting of what are termed "noise sensitive developments" such as dwellings and schools in noisy environments, and "conversely, the construction of a noise source, such as a road or a factory, near existing buildings". Although advice is also given on mitigation of existing problems, the Report clearly states "it is, of course, far more effective, as well as cheaper, to prevent a problem rather than attempt to cure it."

Surveys of traffic noise have been carried out and although during 1973, concern over helicopter traffic increased rather than diminished, it was not possible for very much work on this aspect to be done.

There is an interesting section dealing with acoustics and insulation and the noise nuisance often associated with ventilation equipment. An interesting sidelight is expressed as follows: "While keeping noise out of buildings is generally the desired aim, there have been several instances where advice has been sought on keeping it in. This particularly applies to youth clubs and places where 'pop' music is played at very high sound level. The great difficulty in this work is to allow the heat generated by a large crowd of youngsters to be dissipated without the noise, associated with their activities, escaping."

"The quality of the air in large cities is now, more than ever before, recognised as an important factor in the standard of urban life." So starts that section of the Report dealing with air pollution. Once more there is a consideration of new and impending legislation, but the most interesting reading is that section of the Report dealing with the present situation in London. For the Inner London measuring sites the year ending September, 1973, yielded an annual average of 122 microgrammes per cubic metre for sulphur dioxide. This is plotted on a graph with readings for earlier years, and though it is clear from the graph that the improvements made in sulphur dioxide levels in recent years have been considerable "the level is still among the worst for British cities and more than twice the recommended long term goal for this pollutant set by the W.H.O. expert committee". It is suggested that the improvement obtained is more of a bonus than as a result of any new specific control.

On the other hand, the smoke levels in inner London are now quite near to the W.H.O. goals. The Report continues "the question arises therefore; how can sulphur dioxide levels be further reduced?" The G.L.C. consider that an answer is especially important because of the C.E.G.B.'s proposals for new generating stations in the London area and because of economic pressures that may be brought to bear on favouring the use of high polluting fuels.

As regards carbon monoxide, while acknowledging that there has been no recent systematic attempt to assess its significance in the London area, the Report states that the limited evidence so far available suggests that the W.H.O. goal for carbon monoxide is well exceeded in particular situations, and a study is planned for 1974 "with the object of throwing some light on pollution in London streets and of devising appropriate methods for obtaining information that can be used by planners in connection with traffic management schemes, road construction, housing development near roads and so on."

It is considered that there is inadequate information available at present on the concentrations of several other potentially important pollutants in London's air one of them, of course, being lead.

Special activities have been carried out in connection with planning proposals for power generating stations, the question of gas washing at Battersea Power Station, the Oxford Street traffic management scheme and high density development proposals.

Other sections of the Report deal with the work of the building sciences and material sciences group and their investigations into the suitability, durability and the like of very wide range of materials used in building; there is a special section on the work of the analytical group and a section devoted to the work of the technical services group and fire-brigade support.

This is a Report which is illuminating and readable. It may be borrowed from the Society's library.

Oil—The Biggest Business
Christopher Tugendhat and Adrian Hamilton. Eyre Methuen. £6·25. 382 pages.

The first part of this book, written by Christopher Tugendhat, describes how the industry grew up from 1859, when Edwin L. Drake drilled the first well in Titusville, Pennsylvania, through the dramatic period of the great oil barons such as John D. Rockefeller, Henri Deterding and Calouste Gulbenkian, up to 1960 and the formation of the Organisation of Petroleum Exporting Countries, when the industry finally achieved its present form. In the second part, Adrian Hamilton discusses such crucial questions as the pursuit of oil as a political weapon, how deep is the confrontation between producers and consumers, and where the industry as a whole stands today at a time when governments are becoming increasingly involved. Questions are asked and attempts are made to answer them. How real are the fears of the environmentalists? Where is oil likely to be found in the future? How real is the energy crisis? How can natural gas be exploited to its fullest potential?Where do the North Sea discoveries fit into the economic fortunes of the British Isles?

Undoubtedly this is a fascinating book which makes exciting reading. It is well written and extremely readable.

Today oil is the most important single commodity in world trade, probably the most important source of energy and one of the most important raw materials for the manufacture of chemicals. Nearly every one of us uses oil in one way or another in our daily lives although we do not always realise it; nor do we realise how much we depend on it. The present energy crisis has at least partly brought this home to many thinking people, but the fact remains that though many people would say they are interested in oil, and in spite of all that they can read about the oil industry and its efforts to supply our needs in the daily press, they have still tended to gain their knowledge, and to some extent form their opinions of the industry from such television programmes as the portrayal of the Mogul Oil Company. But for anyone who wishes to be informed of the realities of the situation, this book provides the answer and is indispensable reading.

The first edition was published in 1968. It has now been brought fully up to date and was re-published in January, 1975. Oil, and energy, will continue to play an even more crucial part in our national life; to some extent the future prospects for Great Britain depend on the future prospects of North Sea oil. In this situation it is fitting that heed should be paid to the arguments presented by Messrs. Tugendhat and Hamilton even though we may not always agree with the conclusions they reach.

The book is well produced, has a useful index, a select bibliography and contains a number of useful appendices giving facts and figures.

We thoroughly recommend this work as compulsive reading.

New additions to the National Society for Clean Air Library, available on Loan

Oil: the biggest Business—by Christopher Tugendhat and Adrian Hamilton. Published by Eyre Methuen.

The Determination of Sulphur Dioxide in the Ambient Atmosphere—A survey of some interference effects—Technical Report by G. B. Marshall, Central Electricity Research Laboratories, August 1974.

British Gas Corporation—Annual Report & Accounts 1973-74.

Health Guide to BP Petroleum.

An Assessment of the Hayes Shell—Cast Cokeless Cupola—Paper by L. Bergqrist, R. J. Taft—Esso Research Centre, Abingdon, Berkshire.

Environmental Protection in the Aluminium and Non-Ferrous Smelting Industry—Symposium—English translation by E. J. Groom, Esq., Technicopy.

Air Pollution Abatement & Regional Economic Development—William H. Miernyk and John T. Sears, Lexington Books.

Directory of Pollution Control Equipment Companies in the E.E.C.—Edited by R. Whiteside and H. C. H. Whiteside.

"A Study of the Costs of Residue & Gasoil Desulphurisation for the Commission of the European Communities"—Supplement to report number 13/72. Prepared by R. J. Ellis, Chairman of the Concawe Ad Hoc Group.

"Experts on Desulphurisation"—Stichting Concawe, The Hague.

The Dispersion from a Complex of Stacks: Calculations with Data from several Industrial Complexes in the vicinity of Ingolstadt (Western Germany)—Report number 3/74. Prepared by Concawe Air Pollution Special Task Force 1: Stichting Concawe, The Hague.

Philosophy & Environmental Crisis—Edited by William T. Blackstone.

Combustion—Formation & Emission of Trace Species—By John B. Edwards, Adjunct Professor, Department of Chemical Engineering, University of Detroit. Ann Arbor Science Publishers.

Clearing the Air, Federal Policy on Automotive Emissions Control—By Henry D. Jacoby, John D. Steinbruner and others. John Wiley Publishers.

Cadmium in the Environment—Second Edition, The Chemical Rubber Company Press.

The Chemistry of Polychlorinated biphenyls—The Chemical Rubber Company Press.

LIST OF CURRENT PUBLICATIONS RECEIVED BY THE N.S.C.A.

Journal of the A.P.C.A.	*monthly*
ATOM	*monthly*
The Chemical Engineer	*monthly*
The Council of Europe News Sheet ...	*monthly*
The Council of Europe Forward in Europe	*quarterly*
The Ecologist	*monthly*
Electric Vehicles	*quarterly*
Energy World	*monthly*
Environmental Health A.P.H.I.	*monthly*
Environmental Science & Technology ...	*monthly*
Gas Marketing	*monthly*
The Heating & Air Conditioning Journal	*monthly*
Municipal Journal	*monthly*
Municipal Engineering	*monthly*
Municipal Review	*monthly*
Nature in Focus	*monthly*
Pollution Monitor	*monthly*
Solid Fuel	*quarterly*
Town & Country Planning	*monthly*
WHO Chronicle	*monthly*
Esso Magazine	*quarterly*
Petroleum Review	*monthly*
Motor Transport	*weekly*
Modern Medicine	*monthly*
Industry & Society	*weekly*
Bulletin of Commission of the European Communities	

The Leverhulme Project Loughborough University of Technology

Courses to be held at the University during 1975 include a repeat of last year's very successful one week course 'Air Pollution Measurement and Environmental Control' and a completely new course 'Environmental Noise Pollution'. These subjects were felt to be of topical interest, the most so since current legislation will impose certain obligations on both industry and the public service in the field of pollution control.

The course on air pollution, which was designed to provide an understanding of theoretical aspects of air pollution with practical examples of the solution of pollution problems, will be held on April 13-18 and September 14-19, 1975. Although designed as an integrated one week course, the content covers different subjects each day so that attendance on particular days only can be arranged.

The second course, 'Environmental Noise Pollution' is in three stages, commencing 17-18 April and includes a period of home study. The aim of this course is to provide an understanding of noise and noise control with emphasis on the planning and legislative aspects in relation to the external environment.

Brochures and further details on both courses may be obtained from: Mrs Sonia Withers, Centre for Extension Studies, Loughborough University of Technology, Loughborough, Leics. LE11 3TU. Tel: Loughborough (0509) 67494.

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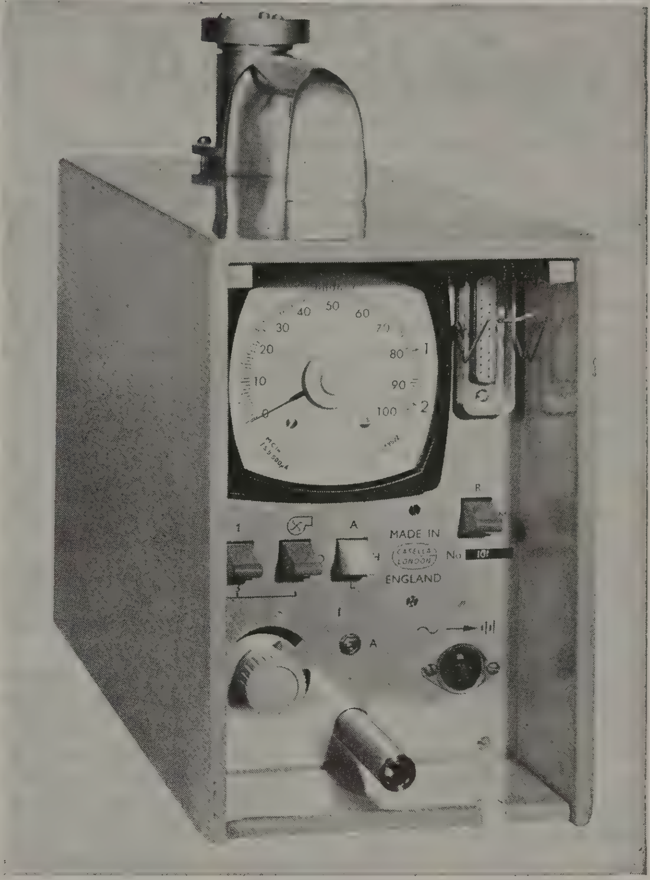

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Reader Enquiry Service No. 7538

INDUSTRIAL NEWS

The Electricity Supply Industry's Role in District Heating

Regional teams comprising personnel from both the Central Electricity Generating Board and Area Electricity Boards have been established by the electricity supply industry to give careful study to any potentially viable district heating schemes arising within their area.

Mr. Gerald S. West, of the Electricity Council, revealed that, since the teams had been established, 21 schemes for district heating had been put forward for consideration, and while it would be premature to give any indication of the outcome, the coverage varied from compact city centre developments, and hospital and education complexes to large redevelopment or new town areas. Predominantly these were in reasonable proximity to existing power stations.

He added that, with regard to heat supplies to industrial and commercial sites, ten possible schemes had been suggested and were being carefully studied.

"The one feature that stands out clearly in these investigations," said Mr. West, "is that they require the objective collaboration and co-operation between the different parties involved—the supply industry as the heat supplier, the consultant, the heat contractor and, of course, the developer acting on behalf of the ultimate consumer.

"I have mentioned the ultimate consumer last, but we must all remember that all that we are doing is on his behalf. It is our task to provide him with an improvement to his living standard at prices he can afford and without any burden being placed upon the community at large."

Mr. West stressed that the criterion on which any scheme would be judged would be that of economic viability. It was a particular responsibility of the supply industry that it should secure an adequate return on the investments it made.

In the introduction of district heating schemes linked to combined heat/electricity supply plant, the risk arose that large amounts of capital might be invested but the heat load not materialise as quickly as was expected. One approach to this problem would be to build up the district heating system gradually, using direct heat supply from local boilers until an adequate heat load had developed. Then the district heating scheme might be coupled to a new heat/electric station or a converted existing station, and the local boilers relegated to a standby role.

It was interesting to observe, Mr. West pointed out, that in Europe the combining of a district heating scheme with a heat/electric power station was the exception rather than the rule. In West Germany only about one scheme in four was associated with a heat/electric power station and in Russia the indications were that this fell to about one in five. Only where large conurbations were totally supplied with district heating was there a case for using anything but a small turbine set.

In Vasteras, which began its district heating scheme in the early 1950s, it was not until 1963 that the two 44 MW turbines were installed to take over the heat supply function and not until 1969, when virtually the whole town was supplied by the district heating scheme, that the 215 MWe turbine was commissioned.

Dealing with the practicalities of making heat available from an existing power station, Mr. West said it would not be a feasible proposition to convert a large modern set to back-pressure operation—that was, to exhaust the steam direct to the district heating system. Firstly, the amount of heat was far too great: one standard 660 MWe unit if modified in this way would produce about 1000 MW of heat—enough for a heating scheme to serve some 400,000 people.

Secondly, since a modern power station, with large generating sets and with an expected life sufficiently long to warrant connection to a district heating system, might well be at a substantial distance from the heat load, transmission mains would need to be provided. The technology of transmission and distribution of heat, whether by hot water or steam, did not appear to present any noteworthy technical difficulty, but the capital cost would be substantial and the heat losses might well be in the range of 10-20% of the total heat supplied.

Modification of the smaller sets in urban stations would substantially reduce the transmission costs; however, these were less efficient than the large sets in modern stations, and additional costs and fuel requirements will be incurred if these are run to provide district heating at times when they would otherwise be shut down. Similarly, if new small back-pressure steam turbines were installed in urban stations, their higher capital and operating costs relative to large condensing turbine sets would be a disadvantage.

An alternative way of producing hot water was to mount a heat exchanger in the exhaust of a gas turbine station. This would produce heat at a fully useful temperature with no significant loss of electrical output. A typical installation generating 60 MW of electricity could supply about 100 MW of heat. Heat was made available at the capital cost of the heat exchanger and associated pipework and auxiliaries and at the expense of longer running of the gas turbine to meet the heat load than would be required in meeting electrical peak-load duty only. The high operating costs of the gas turbine with its high fuel cost and low efficiency were in excess of the operating costs of the power station that would otherwise be generating, and this excess cost incurred represented a debit to the heat supply provided by the gas turbine.

"The economics of each of these methods of providing heat from power stations are being re-examined in the light of the recent abrupt rise in fuel prices that has taken place. It is hoped that opportunities may exist for both small and medium sized district heating schemes," said Mr. West.

Sir Peter Menzies, Chairman of the Electricity Council, was on February 4 elected President of the District Heating Association at the association's annual meeting in London. He succeeds Lord Greenwood of Rossendale.

Sir Peter, commenting on his appointment, said: "I am particularly happy to accept this office, not least because it demonstrates that the electricity supply industry is not opposed to the district heating concept, as some have alleged. The contrary is the case, although the industry does try to be objective.

"We are willing to study with care any potential schemes which, on the face of it, seem attractive. Indeed, there are currently a number under review by the supply industry. Certainly, each case will be looked at on its merits".

The Association also elected as Vice-President Mr P. A. Lingard, Chairman of the East Midlands Electricity Board.
Reader Enquiry Service No. **7539**

Philips Professional Profile. Issue No. 1. Pollution and the Environment

The international Pye and Philips Group of Companies has many roles to play in conserving natural resources and raw materials. Philips are concerned about all aspects of the environment and have already turned their attention to seeing what positive contribution they can make to improving the conditions in which we live. As an expression of the serious view they take of the work they have now completed and that which still remains to be done, they have devoted the first issue of a new publication, 'Philips Professional Profile', to explaining some of the projects which are concerned with pollution in all its facets.

Included among many interesting articles are a description of a monitoring network for SO_2 and other pollutants in the Netherlands and a new development of the Stirling engine.
Reader Enquiry Service No. **7540**

Running Tests on Stirling Efficiency

With pollution and noise control currently under attack, the Stirling engine is again receiving attention as a possible power source. Using external combustion, it can burn a variety of fuels and has advantages as a small power source. International Research and Development Co. Ltd. has taken over two engines made by the Universal Stirling Engine Co. Ltd. with a view to examining their performance, particularly for specialist applications such as small efficient underwater power sources. Running tests have already been started to determine efficiencies.

This work is an example of IRD's interest in the more efficient use of energy. Other typical projects have concerned the design of district heating schemes and improving the efficiency of the gas turbine cycle by adding a refrigerant cycle to make use of the waste heat.

(IRD Newsletter)

Reader Enquiry Service No. **7541**

Fuel Bills

Fumes and odours from food and animal by-products processing plants, sewage works and plastics curing ovens can be most unpleasant. Incineration is the most effective way of destroying such fumes and odours —but conventional incinerators, which require an air temperature of about 800°C to achieve oxidation of the organic vapours causing smells, can be expensive to operate in these days of high fuel costs.

Now, John Thurley Ltd., the Harrogate-based firm of combustion and chemical engineers, has introduced the 'Flo-Cat' range of catalytic incinerators designed to kill industrial fumes and odours at comparatively low temperatures (350-450°C) and lower fuel costs.

This is achieved by passing the preheated foul air through a carefully selected catalyst. Further fuel savings can be achieved, in many cases, by using the hot gases leaving the 'Flo-Cat' to preheat the incoming fumes.

'Flo-Cat' incinerators are based on well-proved Thurley combustion equipment and Kali-Chemie Engelhard catalysts allied to fully automatic temperature and safety controls —the latter to British Gas Corporation standards. Each catalyst carries an 8000-hour guarantee.

Designs are available to cope with 500 to 10,000 s.c.f.m. of exhaust gas from such sources as food processing equipment, animal by-products processing, plastics curing ovens, offset printing equipment, sewage treatment plants, wire lacquering ovens—and many others. Larger or smaller units can be supplied if necessary.
Reader Enquiry Service No. **7542**

Recycling in Plastics and Paper Industries

Should Government be encouraging industry to recycle waste materials? Is recycling economically viable? Does industry need incentives if it is to recycle on a larger scale?

Queen Mary College has recently been awarded £93,000 by the Wolfson Foundation to set up a research unit which will provide the kind of information needed if these crucial questions are to be answered. This three-year project will analyse the technological and economic case for recycling in the plastics and paper industries.

Both industries already practise recycling—about a third of waste paper is reclaimed, and a much smaller proportion of plastics. Before industry invests further capital in recycling, it must be satisfied that the results will be economically viable.

The QMC Wolson Recycle Unit is already working closely with industry to evaluate processes currently in use and proposals for recycling Mathematical models are being constructed which will allow comparison of profitability of alternative recycling processes.

Dr T. S. McRoberts, Director of the Unit, says, "Industry, government and university researchers need a framework for comparing the viability of recycling processes. Our work will provide this framework for the plastics and paper industries. We expect that later we will be able to apply our methods to other industries —such as metals and glass."
Reader Enquiry Service No. **7543**

Order for Gas Cleaning Plant for Melting Shop Fume from Electric Arc Furnace

An order valued at more than £550,000 has been placed with Peabody Holmes Ltd., by the British Steel Corporation for a bag house gas cleaning plant for a melting shop containing an 80-ton electric arc furnace at the River Don Works, Sheffield, Special Steels Division, of the British Steel Corporation.

The plant is designed to handle a maximum of 14,150 actual cubic metres per minute of fume collected from the roof of the melting shop. The maximum volume is only handled when fume and dust emissions from the furnace are at their peak. At other stages during the melting cycle, the volume is reduced to save power. This is achieved by switching from two fans to one fan: fan efficiency is maintained and the absorbed power kept to a minimum.

The gas cleaning plant comprises a bag house filter installation, main fans and filter bag regeneration fan. Also included are the collected dust handling system, dust storage hopper and dust condition.

The plant, which is scheduled to come into operation during the late summer of 1976, will clean the collected gases to give a maximum outlet dust burden of 70 milligrams per normal cubic metre.
Reader Enquiry Service No. **7544**

Waste Solvents Incinerated Without Need for Support Fuel

A John Zink thermal oxidiser unit (ZTO) with special high-intensity burners is to be used to incinerate a wide variety of solvent wastes produced at Merck, Sharp & Dohme's pharmaceutical plant in Eire. The wastes are highly variable in composition, and their calorific values range from mixtures with values of only 5,800 Btu/lb to over 17,000 Btu/lb. Because of this large variation, the temperature conditions required in the thermal oxidation process are difficult to control, necessitating combustion by means of a High Intensity burner.

The high heat release of this John Zink HI burner is due to the way in which the air and combustible are mixed. A high degree of spin and recirculation are achieved in the combustion chamber, and no flame extends beyond the end of the chamber, with the result that a high temperature is maintained and stable combustion is possible even with a fuel of highly variable calorific value.

The thermal oxidiser for the waste solvents, designed as a vertical cylindrical unit with forced-draught operation, can handle from 7,300 gallons/week up to 20,000 gallons/week, depending on the calorific value of the waste. Even low calorific value waste is just self-combusting, so that no support fuel is necessary.

The oxidiser is controlled by modulating the excess air admitted in order to maintain constant temperature in the burner. The intermittent pilot is fuelled by LPG and the unit is fitted with a standard John Zink safety and control system to shut it down in the event of any malfunction.
Reader Enquiry Service No. **7545**

Sludge Incineration Plant for Wigan Under Way

The erection of the multiple hearth furnace for the Wigan sludge incineration plant is well advanced. The basic fundamentals of the furnace, steel shell, refractory lining and internal castings are complete. The furnace will form the centre piece of a fully integrated, continuous process plant incorporating sludge thickening, conditioning, dewatering and incineration. This equipment is being supplied by Eimco (G.B.) Limited for Leonard Fairclough Limited, who are the main contractors for this and other contracts on site.

The consulting engineers, Ward Ashcroft and Parkman, have designed the plant to convert 50 cubic metres per hour of 97% moisture sludge to 0·5 tonnes per hour of quenched ash. The basic engineering concept around which the plant has been developed, is that the total process from pumping of the thickened sludge to ash removel is completed within the hour. The means of dewatering will be by centrifuges, thus allowing the processing equipment to be housed within one compact building. Other ancillary equipment, including exhaust gas cleaning by Ambuco Limited, will also be housed within the building.

An interesting and unique feature of the complex will include air flotation of the centrate to complete solids recovery and possibly to reduce conditioning costs. The concentrated float will be pumped back to the furnace.
Reader Enquiry Service No. **7546**

Hygrotherm Anti-Pollution Incinerator for Lindsey Oil Refinery

An anti-pollution incinerator is to be supplied by Hygrotherm Engineering Ltd, Manchester, to Lindsey Oil Refinery Ltd to destroy odours from off-gases at their Killingholme refinery in South Humberside. The contract includes steam generation plant making use of heat recovered from the incinerator exhaust gases.

The incinerator will deal with off-gases from three sources—a sour water stripper off-gas containing hydrogen sulphide and ammonia, ejector off-gases from the vacuum distillation unit, and a crude oil distillation unit. The combustion support fuel will be refinery gas of varying calorific values. This tolerance, both of support fuel and effluents, is characteristic of a Hirt burner which is the basis of a Hygrotherm incinerator.

A waste heat boiler will recover sufficient heat from the exhaust gases to generate 15,000 lbs/hr of steam. A superheater on the steam boiler will raise the temperature to 300°C/17 atmospheres pressure.

The complete installation will be within the refinery area and it is being designed to comply with safety requirements, including an air-purged control panel, spark-proof motors, flameproof pressure switches and pneumatic controls wherever practicable.
Reader Enquiry Service No. **7547**

New Burner Saves Fuel and Cuts Costs

British Gas has produced a new type of burner that will help industrial customers to conserve valuable fuel and reduce production costs.

The gas burner makes waste heat recovery—an important means of improving fuel efficiency—a practicable proposition for the smaller range of kilns and furnaces, with potential gas savings of up to 45 per cent and even higher in some cases. Because of the cost and size of the necessary equipment, waste heat recovery has previously been confined to large-scale plant.

The new unit, designed and developed by a team of combustion engineers at the Midlands Research Station, Solihull, combines the functions of burner, flue and recuperator in a single unit, but can be installed as easily as a conventional burner.

Besides achieving a large increase in thermal efficiency, the new unit entirely eliminates the need for flue ducts in the hearth of the kiln or furnace, reduces the number of burners and allows economical fitting of flame protection equipment.

For the ceramics industry, it fills a particular need. In ceramic processes large amounts of water have to be expelled from the ware in the initial drying cycle. For one company, the new burner has reduced this cycle from 50 to 35 hours and consistently shown fuel savings of 40 per cent.
Reader Enquiry Service No. **7548**

CLEAN AIR

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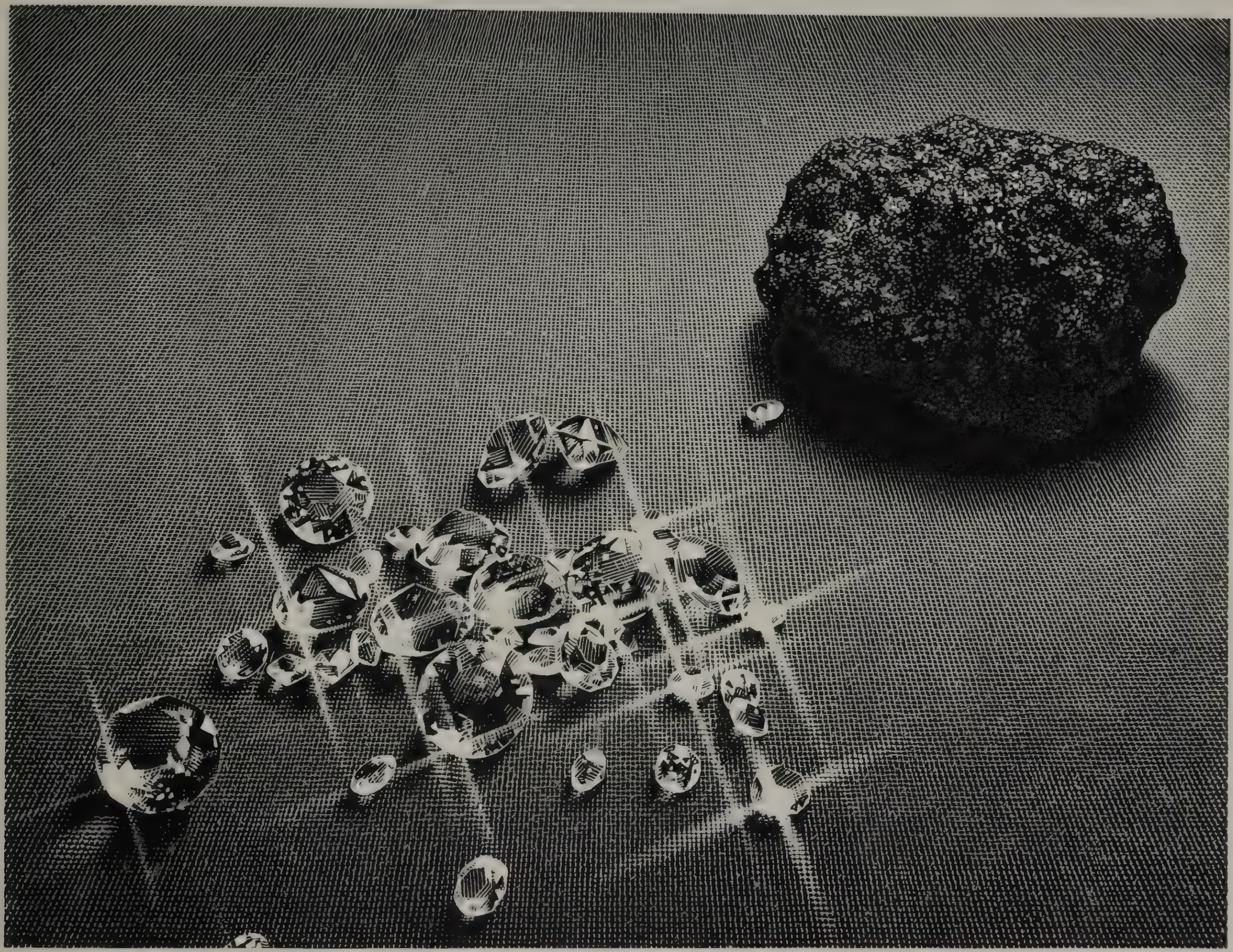

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Reader Enquiry Service No. **7549**

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Civic Trust Award	1959	Tafalog Weir, Dolgarrog
	1962	Felin Newydd Weir, Rheidol
	1968	West Burton power station
	1969	Midlands Region HQ, Solihull
Welsh Tourist and Holidays Association Award	1964	Stwlan Dam & Rheidol Valley
Countryside Award	1970	Didcot nature trail
	1970	Drakelow field study centre
	1970	Hartlepool field study centre
	1970	Peterborough land reclamation
	1970	West Burton landscaping
RICS/Times Conservation Award	1973	Wymondley substation site
Arnold Marsh Clean Air Award	1973	CEGB cleaner air development

Reader Enquiry Service No. **7550**

BRITAIN'S LEADING AIR POLLUTION JOURNAL

CLEAN AIR

SUMMER 1975
VOL. 5 NO. 18

PRINCIPAL CONTENTS

A Fourth Dimension—Recreation and Amenity
John Humphries

The Incineration of Waste Liquids and Solids
J. I. Morris

Fume Incineration
M. D. Ward

The Heating and Ventilating of Buildings by Direct Gas Firing
K. H. Smallman

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Reader Enquiry Service No. **7551**

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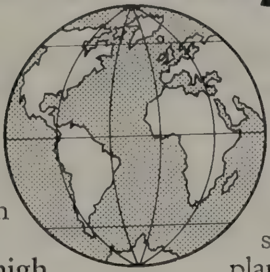

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INTERNATIONAL CLEAN AIR AND POLLUTION CONTROL CONFERENCE

incorporating the 42nd ANNUAL CLEAN AIR CONFERENCE

20th—24th OCTOBER 1975

THE DOME, BRIGHTON

OPENING SESSION—MONDAY, OCTOBER 20

Civic Welcome by the Mayor of Brighton.

Formal Opening by Mr. B. Shindo, President of International Union of Air Pollution Prevention Associations, Tokyo.

Presidential Address.

SESSION TWO—TUESDAY, OCTOBER 21
INTERNATIONAL ATTITUDES TO THE CONTROL OF POLLUTION

A Comparison of Approaches.
Dr. L. E. Reed, Department of the Environment, Central Unit on Environmental Pollution.

The United Kingdom Approach and its Application.

(a) By Central Government.
M. L. Tunnicliffe, H.M. Deputy Chief Alkali and Clean Air Inspector,

(b) By Local Government.
T. H. Iddison, M.B.E., Chief Environmental Health Officer, Dartford.

The European Approach and its Application.
The E.E.C. Philosophy of Application.
S. Johnson, E.E.C., Environment and Consumer Protection Service, Prevention of Pollution and Nuisances Division.

The E.E.C. Approach to Medical Standards.
Dr. P. Recht, E.E.C., Directorate General for Social Affairs, Health Protection Directorate.

A New Approach to Standards.
Dr. L. A. Clarenburg, Rijnmond Authority, Director of Department of Environmental Hygiene, Netherlands.

SESSION THREE—WEDNESDAY, OCTOBER 22
ENERGY FROM THE CONTINENTAL SHELF

Exploration.
J. M. Bowen, Director (Exploration) Shell Exploration and Production Ltd.

Production and Pollution Control.
F. G. Larminie, The British Petroleum Co. Ltd.

North Sea Oil—In Context and Perspective.
H. B. Greenborough, Chief Executive, Shell Mex and B.P. Ltd.

SESSION FOUR—THURSDAY, OCTOBER 23
TECHNICAL ASPECTS OF THE CONTROL OF INDUSTRIAL POLLUTION

(a) Gaseous Emissions.
J. P. Detrie, Director, Centre Interprofessionel Technique d'Etudes de la Pollution Atmospherique, France.

(b) Effluents.
Dr. F. Malz, Emschergenossenschaft, W. Germany.

(c) Solid and Toxic Wastes.
R. A. Fish, Greater London Council, Scientific Branch.

SESSION FIVE—THURSDAY, OCTOBER 23
CONSERVATION OF RESOURCES

(a) Human Resources.
Professor C. E. Barthel, Jr., Miami University, U.S.A.

(b) Energy and Raw Materials.
Professor F. Roberts, Brunel University.

SESSION SIX—FRIDAY, OCTOBER 24
POLLUTION FROM ROAD VEHICLES

(a) The E.E.C. Philosophy of Control.
D. Verdiani, E.E.C., Directorate General XI.

(b) The United Kingdom Philosophy of Control.
Dr. Stuart Reed, Greater London Council, Scientific Branch.

(c) The Technical Problems of Control of Pollution and Noise.
D. Collins, Ricardo & Co. Engineers (1927) Ltd.

CLOSING SESSION—FRIDAY, OCTOBER 24

12.00 CLOSING ADDRESS—The President.

Programme of films about pollution will be shown in the Pavilion Theatre at 14.30 on Tuesday, October 21, at 16.30 on Wednesday, October 22 and at 14.30 on Thursday, October 23. A special programme of films on specific subjects will be shown at 16.30 on Tuesday, October 21, and a programme about North Sea oil will be screened at 14.30 on Wednesday, October 22.

The Social Programme will include visits to the Roman Palace, Fishbourne; Kipling's House, Batemans; Petworth House; Sheffield Park, Horsted Keynes and a trip on the Bluebell Line, on October 22; Preston Manor and Brighton Corporation's Nursery Gardens, Stanmer, on October 23.

The Civic Reception and Dance will be held on October 23 at the Royal Pavillion by courtesy of the Mayor and Corporation of Brighton.

CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

Vol. 5 No. 18 **Summer 1975**

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"This most excellent canopy, the air"

CLEAN AIR

Annual Stock-taking

It is now just over twelve months since at an Extraordinary General Meeting, the Society adopted its new Memorandum of Association, new Articles of Association and new By-Laws which embodied changes designed to enlarge the Society's horizons and to fit it better for its task in the future in the light of, among other things, local government reorganisation. It is therefore now not inappropriate to try and take stock of what has happened in that twelve months and see how the Society is facing up to its new role.

First, it must be said that this has been by no means an easy year. The changes in local government had a deep effect on the membership of the Society for, on 31st March, 1974, all the 'old' local authority members ceased to be members and it was necessary to try and recruit as many of the new local authorities as possible. This, of course, started before the 1st April when the new local authorities assumed their responsibility, but it was to be many months before it became clear which authorities had taken up membership of the Society. Even today we still find some authorities who have not officially become members but who think that they are members; and there have been cases of other local authorities who had every intention of joining but in fact have failed to do so through some administrative oversight. However, in spite of all the difficulties, the response from local authorities has been quite good and the Society once more has a representative local authority membership. Nevertheless, there are gaps, and notable gaps at that. There are some authorities who have been members of the Society for many years but who have failed to become members following reorganisation. In fact, a list of those authorities who are not members has proved to be more illuminating than a list of members, as it has shown exactly what gaps there are. Efforts naturally are now being made to close these gaps and to induce such authorities to become members. Now similar changes are taking place in Scotland and it is necessary to start the exercise all over again for the Scottish authorities. However, to some extent Scotland has benefited by seeing what has happened in England and Wales during the last twelve months and a good start has already been made to recruit as many as possible of the new Scottish local authorities.

Although, as has been said, the results have been reasonably satisfactory so far, there has been one notable lack and that is that there has been a marked reluctance on the part of County Councils to become members of the Society. The argument is raised that it is the District Councils who are responsible for clean air and that therefore there is not the same need for counties to become members of the Society. On the other hand, counties although not directly responsible for environmental health matters, are nevertheless responsible for such matters as waste disposal; and perhaps in some cases it is not yet fully realised how important is this matter of waste disposal in the field of the environment and environmental health. Counties too are responsible for education; and education about the environment, about clean air and the control of pollution is of ever-increasing importance and is making increasing demands on the Society. Every day we are asked to provide information to schools and to school children on these very important subjects. The new article 3 in the Memorandum of Association lays particular stress on education in all its aspects. This is a very important part of the Society's work and it is hoped that in future we shall be able to persuade the county authorities to support us accordingly. Planning too, these days, is an essential part of any work designed to improve the environment. Here again, with their planning, the County Councils are involved, whether they like it or not, directly with the environment and so this is a further reason why we should seek their support.

Inevitably there has been some upset while these changes have taken place. It has been particularly difficult in the field—in the Division—where much sorting out has been necessary. Until such time as the Divisions knew who their members were they were not in a position to go ahead with their activities. Consequently there has been a reduction in Divisional activities in the form of meetings, visits and outings as such. Nevertheless, a tremendous amount of work has been achieved in the background by Divisional Councils and by the Honorary Secretaries of Divisions and it is fitting that this should be recognised. What is more significant is that in the last few weeks there has been a notable recrudescence of Divisional activity and meetings have been held all over the country. This is a healthy sign which augurs well for the future.

Side by side with these domestic happenings within the Society has been the new legislation which reached the Statute Book during the last twelve months. In July, the Royal Assent was given to the Control of Pollution Act. This is the first Statute addressed solely and specifically to the various forms of pollution and it reflects the increasing concern and interest shown for the subject by all sections of the community. Its provisions will impose new duties and responsibilities on County Councils, District Councils and Water Authorities; and it alters the roles which these authorities have previously assumed. Inevitably, these changes will have a significant impact on those in industry, commerce and trade, who will be called upon to comply with the requirements of the Act; but if all its objectives are realised, pollution will be reduced, the environment will be afforded greater protection and the quality of life enhanced.

The Health and Safety at Work Act also received the Royal Assent at the same time. The main purpose of this measure, as its name suggests, is to provide for one comprehensive and integrated system of law dealing with health, safety and welfare of work people and the health and safety of the public as affected by work activities. It is this latter requirement which will affect previous legislation regarding air pollution. As a result of this Act, the Alkali and Clean

Air Inspectorate are now responsible to the new Health and Safety Commission and Executive. Consultation Papers on various parts of this new legislation have now been issued to those concerned by the Department of the Environment and the Society has been given every opportunity of making its views known. This is important work which it is hoped will lead to the bringing into operation of this new legislation as soon as possible.

Turning briefly to domestic smoke control, things might have been better as was pointed out in the editorial in our last issue. Nevertheless, during the last twelve months, the differentiation between 'black' and 'white' areas for smoke control has been abolished and this we regard as a step in the right direction. But this in turn means that there is much work for the Society to do in persuading authorities all over the country—especially those who were formerly designated 'white' and have done very little about smoke control so far—to press forward their smoke control programmes as far as the economic situation will allow, observing that smoke control is in itself a way of conserving fuel and energy.

Summing up, although on the face of it there might seem to have been a small decrease in Society activities, especially in the Divisions, in fact a tremendous amount of work has been done and much has been achieved. The reorganisation of the Society has taken place; the Annual Conference and the Spring Seminar have been held as usual. We still have a sound local authority membership, we have still been in the position to encourage local authorities to proceed with their smoke control programmes; we have been called upon to give our views to the Department of the Environment regarding the implementation of legislation and we have been given the opportunity of presenting evidence to the Royal Commission on Environmental Pollution. Now, with signs of increasing activity in the Divisions of the Society, with many new faces at the meeting of the Council of the Society, we are in a sound position in which to go even further forward.

DIARY OF EVENTS 1975

12th June (Thursday)
Annual General Meeting of East Midlands and Eastern Division
Corby

17th-20th June (Tuesday-Friday)
Warren Spring Laboratory Open Days

27th June (Friday)
Meeting of the Clean Air Council
London

9th July (Wednesday)
1400 ANNUAL GENERAL MEETING OF THE SOCIETY
1500 INSTALLATION OF THE PRESIDENT AND PUBLIC MEETING
THE GUILDHALL, LONDON

15th July (Tuesday)
All day Meeting of the Technical Committee
C.E.R.L. Leatherhead
London and South East and Central Southern Divisional Visit to Vauxhall Motors, Luton

16th July (Wednesday)
Annual General Meeting of Yorkshire Division
Leeds
p.m. Parliamentary and Local Government Committee Meeting
London

24th July (Thursday)
a.m. Conference and Publicity Committee Meeting
London
p.m. General Purposes and Finance Committee Meeting
London

25th July
Copy date for Autumn Issue of 'Clean Air'

30th July (Wednesday)
p.m. Meeting of the Council of the Society
London

4th September (Thursday)
East Midlands and Eastern Divisional Meeting
Peterborough

12th September
Copy date for NSCA Year Book 1976

20th-24th October
International Clean Air and Control of Pollution Conference (incorporating 42nd Clean Air Conference)
Brighton

A FOURTH DIMENSION— RECREATION AND AMENITY

by

John Humphries

Chairman, Water Space Amenity Commission

This, the Ernest Balsom Lecture, was delivered at the Royal Society, London, on 17th January 1975, and is published with the kind permission of the Public Health Engineer.

In a sense it all began with the report of the Central Advisory Water Committee in 1971. Pandora's bottle was un-cawced! The problems which escaped were duly put together again in the Water Act, 1973. Nevertheless in the intervening period there were many diverse views as to what should in fact happen and an example of this is, of course, the address given to you at that time by Lord Nugent of Guildford.

I was blissfully unaware of the problems of the water supply industry, as indeed many of you must have been as well. My primary interest was the world of the canals. I was currently Chairman of the Inland Waterways Association devoted to saving our national heritage of waterways and turning an 18th century utility into a 20th century amenity. I remember advising my Committee at that time that the CAWC Report would not really concern us. How wrong I was to be!

On the 2nd December 1971 the Government published its famous (and in some people's view infamous!) Circular 92/71. This was headed "Reorganisation of Water and Sewage Services". Somewhat to the surprise of the Canal Lobby it contained proposals for the winding up of the British Waterways Board and the distribution of the canal network amongst the new Regional Water Authorities. I suddenly found that along with all other canal enthusiasts I was heavily involved with CAWC. During the following months the Government were bombarded with literature on why their proposals would not work and forces were mobilised to battle with the Bill in Parliament. Simultaneously the House of Lords Select Committee on Sport and Leisure brought out an interim report dealing specifically with water recreation in which they underlined the problem facing the water recreationalist and demanded "a dynamic national policy" for the development of this particular amenity. They swung the weight of their considerable prestige behind the recreational lobby and this at a moment when that support was of vital importance. I myself had given evidence to the Committee and to assist us their Lordships issued their Interim Report before the main report itself was ready. The relevant section now appears as Chapter V of the complete Report of the Select Committee and it is perhaps worth quoting from two paragraphs of that report.

"192 Nevertheless it is essential to maximise the water space available for recreation. There are approximately 300,000 acres of water in England and Wales of which 100,000 are tidal and it has been estimated that up to the year 2000, 45,000 more acres of water storage and 40,000 of gravel pits will be created. This compares with over 3 million acres of land available for recreation. In spite of the accessibility of the sea, the demand for water recreation is so great that a drastic shortage of water space is threatened.

193 There are three ways of getting more recreation on water. To create new water areas is the first; there will be some of these and recreation must be taken into account in planning them. There is obviously a limit to the total amount of water one can create so the second way must be to bring water not now used for recreation into recreational use. Reservoirs are the single largest example of this category at the moment. The third way is to intensify and diversify the recreational use of water already being used for that purpose. This involves capital investment in facilities and also management. The main feature of all British waters, whether they are natural or manmade, is that they have not been designed for recreation. Nor are most managed for recreation. Reservoirs were designed for water storage, canals for commercial carriage, the Broads resulted from peat extraction and gravel pits etc. from quarrying. The recreational element of each is slowly gaining recognition and even overtaking the original use in importance. *The recognition of recreation as a use of water must now be consolidated, with management geared to this use."*

The Government meanwhile had set up a National Conference for the 28th February 1972 to debate the better use of water space and to this they invited representatives of all the recreational and amenity interests.

Three days before this conference, Mr Eldon Griffiths, the Minister then responsible for this particular Bill, asked me to meet him at the House of Commons. At that meeting he told me that the Government had reconsidered certain proposals in Circular 92 and they had decided that they would impose on the new Regional Water Authorities an entirely new recreational and amenity duty. This was the first time that the water industry had had such an obligation (with supporting powers) put on them. Previously when they had provided recreation on their reservoirs they had done so out of their general revenues and largely in the interests of public relations. Very often the water engineers had resisted all pressures to allow the public near the water supply reservoirs for perfectly valid public health reasons—although perhaps in the view of some people with an over-exaggerated fear of contamination. On the rivers, the River Authorities had had very sparse powers and no revenues to develop water recreation at all, except in rare cases like the Thames Conservancy where particular statutory powers existed. Mr Griffiths then told me that in view of the new policy which the Government were developing, they wanted to appoint an Advisor to assist them both in the drafting of the Act and in the development and implementation of this new idea. To my considerable surprise he then invited me to take this appointment.

It is never much fun being asked to change sides and play goalkeeper when you have been scoring as centre forward for the opposition! It was not an easy decision. I asked for 24 hours to consider my position and after a great deal of careful thought accepted on an honorary basis. The chance of getting the recreational voice heard in Whitehall at first hand was too great and too important to be missed.

So the fourth dimension was born and blessed and brought into being, and here I would like to quote from one of the consultation papers issued that August which summed up the then Government's proposals at that time for the reorganisation of the industry.

1 The main purpose of the Government's proposals to reorganise the water services are:

i to secure an ample supply of clean water to meet the growing needs of people and industry
ii to provide adequate sewerage and sewage disposal facilities
iii to clean up most, if not all, the rivers by the early 1980s.

To these three aims has now been added a fourth. For the first time the Government is committed to making the widest possible use of all our water space, not only for the purposes mentioned earlier, but also as an environmental amenity, a recreational asset that ought to be, can be and will be made more fully available to the public as a whole. In promoting this fourth dimension of the Government's national water strategy it is intended that the best use should in future be made of the rivers, lakes, canals, reservoirs, gravel pits and other manmade stretches of water for the wider benefit of sport, recreation, conservation and amenity in the widest sense. It is also intended that the fullest use should be made of inland waterways for freight carrying wherever this can be economically and socially justified.

2 Reorganisation of the water services provides an opportunity for the initiation of this policy on a national scale since the Regional Water Authorities (RWAs) will inherit responsibilities for the following inland waterways which thus will come under direct composite public control.

a the natural rivers and lakes on which river authorities are already responsible for water conservation, land drainage and flood prevention, fisheries and the prevention of pollution. On more than 500 miles of river they will also inherit the responsibilities for navigation.
b the river navigations and canals now administered by British Waterways Board
c reservoirs belonging to statutory water undertakers, river authorities and the British Waterways Board.

These will represent a large part of the total inland waters of England and Wales.

3 The reorganisation also coincides with a visible explosion of interest in water activities of all kinds. It is estimated that there are now some six million people in Britain who regularly engage in land water-based leisure activities and this figure does not include ramblers, campers, bird-watchers and similar casual users of water space. Each summer weekend there are probably more people afloat in boats than there are on all the professional football terraces on an average winter weekend. The number of sailing clubs affiliated to the Royal Yachting Association has grown from 400 to 1,600 over the last 20 years; canoe clubs have increased from 12 to 350 and rowing clubs have doubled. There are estimated to be about 3 million anglers.

4 In addition to all these people, there are millions more directly interested in the benefit which water space can provide in the general improvement of the environment itself. This is particularly true of many of our larger cities where, increasingly, local authorities are realising the significance of water space in their urban redevelopment plans.

5 *It is therefore the Government's policy that the amenity use of water space should be both protected and promoted at both a regional and a national level.*

And so water reorganisation went ahead. You, gentlemen from the world of public health, and I from the world of recreation and amenity, became linked together in this great new industry which today straddles the entire country and forms that interesting machine known as the hydrological cycle. The parliamentary draughtsmen began their task. The Heath Government began to falter. As the Bill went up to Parliament the canal sections were omitted, Local Authority control of the Regional Water Authorities was accepted and finally the Water Act of 1973 became law and the appointed day was fixed for the 1st April 1974. By that date we would have endured the three-day week, the oil crisis, the miners' strike and the change of Government. The recreational child which we had all struggled so hard to bring into the world had been conceived in a time of plenty, born into a time of doubt and seems destined to grow up in a time of total financial stringency.

That then is the background and an explanation as to why you and I are here today. It is also perhaps an apology in advance for the fact that I cannot pretend to a long-standing knowledge of the industry of which we are now all part. I would however hasten to pay tribute to the work which many of my colleagues in the water industry have done over many years and if I have any criticism at all, it is that far too often they have hidden their light under a bushel. A great deal more has been done by the water companies and by the Joint Water Boards than has sometimes been appreciated. It is from the first tentative recreational steps taken at such places as Chew and Blagdon by the Bristol Waterworks Company that the great modern recreational reservoir schemes of Grafham, Empingham and Kielder have all flowed.

But now first a look at the problem. Why should we be so worried about recreational water space?

1 First and foremost because there is so little of it. The following table gives us a rough breakdown of the areas available in England and Wales:

Inland waters—a rough surface analysis is:

	Acres
Reservoirs—Public Water Supply undertakers	
(i) absorbed in water reorganisation	35,000
(ii) not absorbed (water companies)	9,000
Natural lakes—Lake District	13,000
Feeder reservoirs—British Waterways Board	5,000
C.E.G.B.	3,000
Rivers (non-tidal)	90,000
Broads, lakes, canals, small reservoirs and gravel pits	58,000
	213,000
Tidal waters (not including estuaries) are estimated at	100,000

Water Authorities therefore control some 35,000 acres of public water supply reservoirs, together with parts of their gathering grounds, probably in excess of 200,000 acres. Rivers and their floodplains are in multi-ownership and subject to Local Authority powers and to extensive river management powers. Rivers continue to be areas of considerable interest to Water Authorities, Local Authorities, private industry and private owners. The British Waterways Board and other navigation authorities also have considerable interests in river navigations. Artificial canals are almost entirely the responsibility of a particular navigation authority.

New water space assets will mainly be in reservoir and barrage schemes, perhaps to the order of 45,000 acres by the year 2000 and wet gravel pits in the river floodplains perhaps of the order of 40,000 acres by the year 2000.

You will recollect that the House of Lords in their report pointed out that there were 3 million acres of land available for recreation, that is to say, 10 times the area of water and, interestingly, the Ministry of Defence currently control some 600,000 acres of land for their purposes, i.e., an area *double the total water space available in the country*. This emphasizes the scarcity of the basic product which the recreationalists want to use.

2 Then the demands upon it. These were summarised in 1972 in the Government's Circular and all indications are that the numbers are increasing yearly, certainly up to the time of the present financial cutback. Inevitably monitoring demand is extremely difficult and by the time that the statistics are available, much of the research is out of date. Furthermore, the creation of new facilities usually creates the demand. The Select Committee Report states:

"In the leisure field, inspiration and progressive management should be as much sought after as in any other industry; and if suppliers rely on the appearance of demand and on conclusive proof from demand studies before they take action, then they will take action too late." To some extent therefore one has to act on instinct and by keeping one's finger on the pulse of recreational needs. This has never been more necessary than it is now with the changing social and financial problems of the entire country.

3 Thus we have a summary of the basic supply and we have had a summary also of the basic demand. But in this problem of water recreation there is a third factor and that is the competing calls on the water space which the recreationalists want to use. Unlike the land which is available for recreation, most water space is also under pressure for many other purposes. The water itself is a commodity, an essential element, which some users want to extract for drinking, for industrial purposes or for irrigation, while others want to discharge sewage or effluent or land drainage into it. Yet others want to control it for purposes such as hydro-electric power or river regulation schemes. As a result there is an inevitable conflict between the different interests wishing to use that same water.

The fourth dimension therefore which is not in itself part of the hydrological cycle, presents peculiar problems of its own.

How has the Water Act sought to settle and to solve these difficulties? First let us look at the Regional Water Authorities.

The main executive organisation established under the Water Act 1973 is the Water Authority which is responsible directly to Parliament. The Water Act provides for nine authorities in England and one in Wales. Their boundaries are the catchment of a single or of a group of rivers. A Water Authority has absorbed functions and assets from the following authorities:

a River Authorities, land drainage, pollution control water resources, fisheries and water recreation.

b Public water supply undertakings operated by Local Authorities, by joint boards or otherwise (except statutory water companies and certain joint boards and joint committees).

c Sewage and sewerage authorities. As to sewerage, it should be noted that while the functions and assets will be vested in the Water Authority, the latter is under a duty to make arrangements with the local District Council for their operation of the sewerage function on an agency basis.

The ten Water Authorities, their areas and populations are set out in the table below:

Water Authority	*Estimated Area (Acres)*	*Estimated Population*
North West	3,600,000	7,032,000
Northumbrian	2,410,000	2,709,000
Severn-Trent	5,850,000	8,162,000
Yorkshire	3,240,000	4,487,000
Anglian	6,190,000	4,393,000
Thames	3,280,000	12,024,000
Southern	2,650,000	3,676,000
Wessex	2,380,000	2,091,000
South West	2,690,000	1,288,000
Welsh National Water Development Authority		2,924,000

Between them (and excluding local sewerage) the Regional Water Authorities have annual budgets of the order of £400 million on capital account and £600 million on revenue account. The total number of their employees is about 60,000 people and since many of you will be working for Water Authorities, before I look briefly at the national bodies set up by the Water Act, I think it will be helpful to outline the primary recreational and amenity functions of the Water Authorities themselves. I propose to divide these into three; first fisheries, secondly the recreational duties and thirdly the amenity functions. In fact all three inter-relate extremely closely and in many of the authorities, the recreational, amenity and fishery functions are carried out by the same officer reporting to the chairman or one or two committees and sometimes the chairmen carry double functions themselves.

1 Fisheries—Duties

Under the Water Act, 1973, it is a duty of the Water Authority to maintain, improve and develop the salmon, trout and freshwater fisheries and eel fisheries in their area. A fishery is naturally different from fishing which is the act of hunting for sport, domestic or commercial purposes. For practical purposes a fishery can be described as an area of water which contains or is capable of containing fish. As there are commercial as well as sporting uses relating to fisheries, this duty is not regarded as a wholly recreational duty.

There is also a duty to establish advisory fishery committees, a Regional Committee for the area of the Water Authority and such local committees as the Water Authority considers necessary.

Water Authorities succeeded to some 35,000 acres of water in public water supply reservoirs; consequently their ownership of fisheries is considerable and they will, through the use of reservoir fisheries and those in rivers, develop a more integrated service. Reservoirs, for example, can, by planned netting programmes, provide considerable quantities of coarse fish for restocking of rivers to the obvious benefit of the trout fisheries in reservoirs themselves.

However, it must be appreciated that the duty applies to all fisheries in a Water Authority's area whether they own them or not. Further, more fisheries will come into being with the reclamation of polluted rivers. In fact, the maintenance of fisheries becomes a new statutory objective of pollution control. The logical outcome of the duty is a considerable increase in fisheries work, particularly in improving the biological knowledge of inland waters, including the health of fish stocks.

Biological monitoring is being increasingly used. There will be greater emphasis too on works for the improvement of fisheries such as weirs, creation of pools, alterations to banks and so on. The further development of fishery work with an enhanced licence duty and with revenue by the way of contributions from owners of fisheries for advice and services will provide an interesting area of technical and administrative development.

2 Recreation

A Water Authority has a function both to provide and regulate recreation.

As to provision, under the Water Act 1973, a Water Authority and any statutory water undertaker such as a Water Company, *may* take steps to secure the use of water and land associated with water for the purposes of recreation. This function is not confined to the pursuits normally regarded as coming within water recreation.

Where in possession of *rights* to the use of water and land associated with water, the water authority and water undertakers such as Water Companies *are under a duty* to take such steps as are reasonably practicable for putting their rights to the best use for recreational purposes. This includes the setting apart of land for the purpose and provision of buildings and other works—and naturally the power to charge. There must be no obstruction or interference with a navigation not under their control except with consent. This is an extremely wide and important duty—and relatively unique. Recreation is not defined, but can be regarded as any pursuit undertaken during leisure time (that is time available to individuals when the disciplines of work cease and other basic needs have been met) other than those to which people are normally highly committed. The duty is not confined to the many pursuits coming with water recreation. The application of the duty, where practicable, to the 35,000 acres of public water supply reservoirs and their gathering grounds in terms of all recreations suitable is considerable, e.g., hiking, picnicking, camping and informal countryside pursuits. Nor need the locus be rural.

In future, there will be further major water resource developments which will create further water areas, for example, those suggested in the national plan.

The surface developments in the preferred strategy of the Water Resources Board National Plan and which could provide significant areas of water and land for recreation purposes are:

Kielder Water—approved D.O.E.
Brenig —approved D.O.E.
Carsington
Aston
Longdon Marsh
Otmore
Hawes Water
Grimswith
Craig Goch
Brianne
Dee Barrage

These suggested surface developments could provide some 20,000 acres of additional water. Empingham and Wimbleball are under way.

3 Amenity

There is a *duty* with regard to nature conservation and amenity and in relation to the discharge of any of the water authority functions. In proposals for the discharge of any functions the water authority are to consider:

1 preservation of natural beauty;
2 the conservation of flora, fauna and geological and other features of special interest;
3 the protection of buildings and other objects of archaeological and other interests;
4 the preservation of public rights of access to areas of mountains, moors and the like.

There will clearly be considerable opportunity for landscape and nature conservation expertise.

And now a brief look at the two central bodies in the water reorganisation:

1 First the National Water Council. This body has no executive powers over the Water Authorities who are totally independent, but it does have an important national co-ordinating role and is responsible for carrying out functions which can best be done centrally, such as the training of employees, the approval of water equipment and fittings, the running of the pension and superannuation schemes and the raising of large-scale national finance for the industry.

2 Then the Water Space Amenity Commission, the body which I have the privilege to chair. This operates alongside the N.W.C., co-ordinating and advising on recreational and amenity functions throughout England —we have no authority in Wales (although by a rather

delightful anomaly the Welsh National Water Development Authority do contribute towards our expenses!).

The link between all these bodies is extremely close since the Water Authority chairmen sit as members of the National Water Council and also as members of our Commission and I myself sit on the National Water Council as the recreational representative appointed by the Secretary of State. I think this helps to give a family atmosphere to the various bodies and I look upon it very much as a family, with the National Water Council as the father, the ten Regional Water Authorities as the adult sons fully capable of running their own affairs and with no direct parental control over them at all and the Commission perhaps as the younger sister tolerated by her elder brethren who find that she has skills and perhaps attractions which they do not and whose feminine failings and temperament can be quickly forgiven!

In the year in which I have worked in the industry, I have found this a remarkably happy family and external circumstances could scarcely have made life more difficult for all of us.

Now what for the future? The fourth dimension was created at a time of promised prosperity. Amongst the many millions which were to be floating around in the water world, it was indicated that substantial sums would be made available for the development of new recreational facilities, for the improvement of existing ones and that many of the ideas and hopes put forward in the Select Committee Report would become reality at last and at least in the water world.

As we all know, none of this has happened. The Commission not only has no grant-aiding powers, but its costs have to be met by the National Water Council and therefore through them by the Water Authorities. I am glad to say that we are running it on a shoestring at the moment and that our budget is approximately one-half of one per cent of the annual budget of the National Water Council. The Water Authorities too have had to trim their ideas against a background of rising water rates and general anxiety about public expenditure. Inevitably much of the impetus which came from the reorganisation has been lost—but not, I think, abandoned. The enthusiasm amongst the recreational and fishery offices in the regions is immense. We in the Commission are using this period of restraint to co-ordinate the amenity work of the industry and to study what has been done in the private sector and, indeed, abroad. We are updating the resource surveys and working closely with our colleagues in the Countryside Commission and the Sports Council. Above all, we must take an inspired look at the prospects of the next two or three years.

1 Increased financial pressures on public authorities will mean that fewer will provide facilities for leisure and recreation. Increased financial pressures on families will mean that fewer people will purchase more expensive equipment and more will look to the cheaper forms of sport. For instance, already in certain areas we find that some of the more expensive dinghy sailing clubs are feeling the pinch and losing members, but I am sure that angling, which is perhaps one of the more modest costing sports, will show a steady growth.

2 Then again we have to consider the impact of higher petrol charges and perhaps the reduction in the distance which people will wish to travel to enjoy their water recreation. For instance, when various reservoir schemes have been proposed in the past, the catchment area from which participants in water recreation could be drawn has increased over the past 10 years from a radius of 20 miles to a radius of 50 miles. Now I strongly suggest that the radius is shrinking once again. People who do, in fact, travel 50 miles will almost certainly want to spend the weekend at the waterside, which in turn means provision of modest overnight accommodation or camping or caravanning sites. Then again, following the same line of thought, we must consider whether we should not be spending more time and more of the scant funds available opening up the water parks close to our urban areas. These would be particularly the canals and rivers running through our cities, and the considerable areas of gravel pits which very often run down the river valleys. For instance, in London we have the Lee Valley to the east and the Colne Valley to the west, and the water areas in the Colne Valley alone are double those of the whole of the Broads.

These are all particular areas where more thought and more study needs to take place and in a fast changing social pattern, which I think we shall see during the coming eighteen months, the water recreational plans must move with, if not ahead of, the demand.

3 Then on the wider front. If we are to see a shortage of cash what can we do to make certain that that money is better spent and that the best results are achieved for its outlet? Here we must consider the management of existing water areas before we create any new ones. Many areas are currently under-used, partly because most people can only indulge in their water recreation over weekends and during the summer. I believe Education Authorities should be encouraged to take more interest in these areas during term time, particularly since water sports do carry an inherent risk greater than land sports and early training in water safety is of the greatest possible importance. Too often areas such as these have been leased exclusively to clubs. I believe a number of clubs in their current financial difficulties will be only too glad to make them more readily available for public use and this tendency certainly should be encouraged. Let me give you an example. A certain sailing club recently found that the rent of its clubhouse and facilities had multiplied threefold because it had agreed to rent the facilities at whatever rate of interest the water company had had to borrow the money to create those facilities. With a rapid rise in interest charges over the last twelve months, the rent had shot up. At the same time, the membership of the club had dropped by one-third. The club officers approached the Authority and explained their predicament. Clearly the clubhouse could not be pulled down because it had been paid for. Clearly it could not be sold as it sat on the edge of a reservoir. What then was the solution, because, equally clearly, the club could not be subsidised out of the water rates and the building was not suitable for adaptation to other purposes. The solution to this problem lay in the club officials and the Authority meeting the education officers in the area and suggesting that the facilities should be made available for school training during the week with instructors provided from the club and with equipment provided by the club. By the club committee and members providing this free service to the community, there was justification for a partial subsidy for the rent of the clubhouse itself. This surely is the sort of practical solution we should try to find for a situation which nobody could have envisaged and which will be met increasingly often in these very difficult times.

4 Then again in the creation of new facilities, we must provide good forward planning so that we minimise the expenditure of providing the recreational facilities when the new reservoir or river scheme is completed. For instance, recently in the north of England, I visited the site of an enormous new deep reservoir. I asked where the clubhouse was going to be placed and I was told that when the contractors came on site they were directed to put their construction huts in a particular position so that when the huts were removed, the foundations, drains, wiring and approach road for the new sports clubhouse would already be built. This would greatly reduce the cost of putting in the facilities for a multi-purpose unit—and that again is important, because instead of providing separate clubhouses and separate fishing lodges on the same reservoir, it must make more sense to co-ordinate these into a multi-purpose sports use. So forward planning is vitally important and that can be done with a minimum of immediate financial outlay.

5 Finally a word about people, because after all that is really what the fourth dimension is all about. Those of us who come from the voluntary world and have worked with voluntary organisations know the vast enthusiasm and hard work which can be found there. Too often the official world is frightened of the volunteers. They fear that they can be argumentative and unreliable. All of this can be true, but it does not mean that we cannot work together in harmony and achieve a great deal once we begin to understand each other's point of view. In the canal world from which I come, we have proved this emphatically over the past 20 years. If money is short, the volunteers are not. They exist already in nearly every field of water amenity, ornithology, fishing, conservation, waterway restoration, recreational training, youth leadership and many more. I do hope—and my Commission will do all it can in this connection to assist—that those of us in the water industry who want to achieve *positive* progress in these difficult times will go out of their way to bring in the volunteers to assist them with local management and manpower and so share with them the credit for some quite astonishing results.

One of my last jobs as chairman of the I.W.A. before I had to resign to take up my new appointment, was to lead 1,000 volunteers to clean up the Ashton Canal in Manchester. Over that weekend we extracted 5,000 tons of rubbish from the canal which had been especially de-watered for us by the British Waterways Board. The board's engineers supervised the entire operation and at the end of the weekend they claimed that we had saved the board £20,000 by our work. Today the canal is opened again to navigation. This is a simple example of voluntary and official bodies working hand in glove and achieving really worthwhile results.

And so there we must leave the fourth dimension for the moment. Circumstances may have made it shrink in size, but it is still a very potent force. It will need most careful nurturing in the difficult months that lie ahead but, given its fair measure of resources and supported by the ever-mounting pressure of public opinion, it will succeed. And succeed it must. Let all of us here remember that this is almost the only field of our joint endeavour which the public do not take for granted. So long as water comes out of the tap and sewage goes down the drain, no one cares whence they come or whither they go. But pollute a man's fishing, ban his sailing, forbid his canoeing or his water ski-ing or his rowing or his sub-aqua and he will want to know the reason why. The fourth dimension stands out firmly in the forefront of public opinion. If it fails, its failure will be blamed on our industry, but if it succeeds in spite of all our current difficulties, then its success will be not just the success of my Commission, but the success of our new great industry as a whole.

Five Industrial Companies Win First Angling Foundation Awards for Fight Against Pollution

The winners of the first Angling Foundation Gold Medal Awards to Industry, for achievements in the avoidance or abatement of water pollution, were announced in London on April 18, when the successful companies received their awards from Lord Nugent of Guildford, Chairman of the National Water Council.

The two gold medals went to Thomas Bolton & Sons, a Midlands copper-fabricating company founded in the 18th century, and to the giant Distillers Co., which also won a silver medal for a separate anti-pollution scheme at one of its plants.

Other companies gaining silver medals were English China Clays and two international oil firms, Esso and Amoco.

The awards, initiated by the Angling Foundation last year, are for: (a) the best anti-pollution programmes introduced by large companies on a multi-plant or nationwide basis; and (b) the best individual programme at a single factory. Entries were restricted to schemes brought into operation since the beginning of 1973.

Among the winning schemes are programmes which have vastly reduced the discharge of toxic effluents or contaminants into rivers, preserving the purity of some waters so far unspoiled and bringing fish back to others previously abandoned as derelict. Another winning scheme is a new emergency service for dealing with oil spills throughout the U.K.

Energy Conservation and Energy Management in Buildings

A joint conference on Energy Conservation and Energy Management in Buildings is being arranged by the Institution of Heating and Ventilating Engineers, the Illuminating Engineering Society, the Institute of Fuel and the Department of Energy, at the Westminster Theatre, London SW1, on the 13 and 14 November 1975. It is being organised by the Construction Industry Conference Centre Limited. The conference aims to examine what can and is being done to minimise and economise on energy use in our present building stock, how new buildings can be designed to be low users of energy and review future prospects and possibilities. The programme will include sessions on energy problems and policies, saving energy now, economics of energy management, and building design and energy conservation—the future.

It is hoped to arrange a manufacturers' exhibition as part of the conference. Delegates will form a cross-section of building services engineers, architects, lighting engineers, fuel technologists, managers, equipment manufacturers and others concerned to play a part in the conservation of energy.

The registration fee for the conference is £45, which includes preprints of papers, morning coffee, lunch and tea during the conference.

For further information please contact: the Conference Secretary, Construction Industry Conference Centre Ltd., P.O. Box 31, Welwyn, Herts AL6 0XA. Telephone Welwyn 4693.

Progress with Texaco/Octel TI Exhaust Gas Filter

Opinions differ as to whether the contribution of lead from vehicle exhausts to human body lead levels amounts to a significant proportion compared with the much larger quantities of lead ingested in food, drink and other sources.

Nevertheless, it is clearly desirable to reduce wherever practicable the amount of any pollutant which is under our control in the atmosphere. This is why many governments, including our own, have introduced or proposed legislation to reduce the amounts of lead which may be added to petrol to improve octane ratings, allowing the use of high compression, efficient engines.

In general, for each octane number reduction, fuel consumption will increase by about 1·4 per cent. Mr. Eric Varley, Secretary for Energy, has said that the modest reduction so far carried out in the U.K. (from 0·64g/1 to 0·55g/1) has added more than £10m. to our import bill for oil, and that the proposed next step, to 0·4g/1, now indefinitely postponed, would have cost a further £50m.

Texaco, Associated Octel and the two TI companies, TI Silencer Services Ltd and Magnesium Elektron Ltd have developed a vehicle lead trap, which offers an alternative to reductions of lead in petrol.

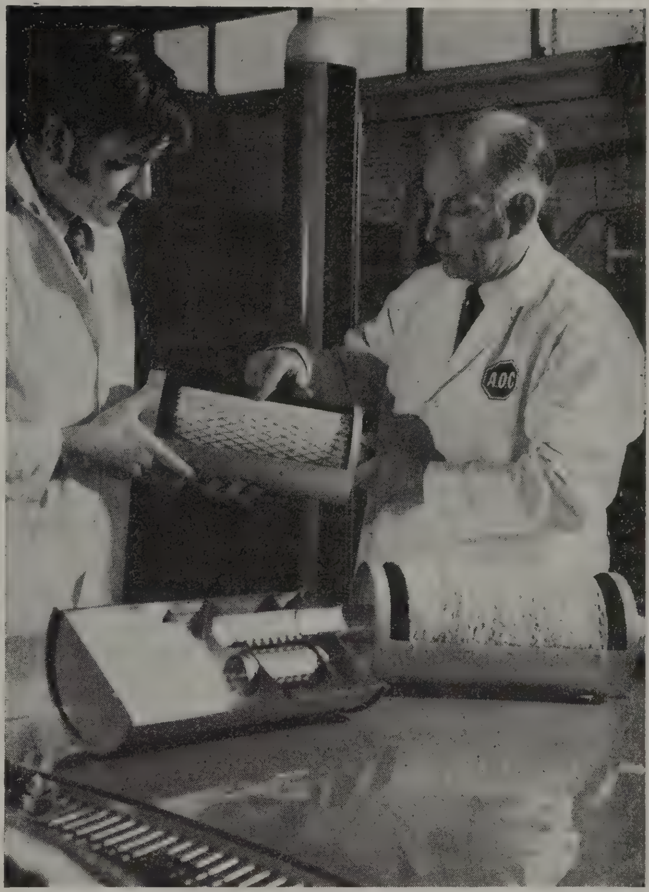
In January of this year the Transport and Road Research Laboratory published their report based on over a year's intensive tests on 20 cars fitted with lead filters produced at TI pilot plants in Manchester and Blackpool. This concluded that the replacement of conventional silencers by lead filters would result in an overall reduction of about 50 per cent in lead emissions. These findings bear out the results of tests by similar bodies in Germany, and France.

This is equivalent to what would be gained by a reduction in lead-in-petrol to about 0·3g/1. The reductions in emissions is about 95 per cent in urban driving conditions, where populations and traffic are concentrated.

Two advances have been made since the filters—an early type—were supplied to TRRL over two years ago.

One of these is the control of the 'purging effect'. The TRRL report, like tests carried out by the developers, showed that under open-throttle conditions when exhaust temperatures are high and the lead halides are in vapour form, filtration is much less efficient. This means that lead trapped during gentler driving could be released during the first few miles of fast motorway driving. The lead emitted during this period would normally be much more than that present in the petrol used over the same interval.

A process has now been developed, involving the treatment of the aluminised stainless steel wool core of the filter with phosphate. Tests at Associated Octel's laboratories at Bletchley, Buckinghamshire, have shown that this reduces the purging effect to less than that which occurs with a standard exhaust system, with an overall improvement in filter performance.



A radial-flow filter is compared with an axial-flow type (right) and a conventional silencer (left)

The other major development affects the overall design of filter. TRRL reported that back pressure had no effect on vehicle performance with the early axial type of filter they tested. The car manufacturers, however, insist on lower back pressure than is attainable with axial designs. Later models are based on a radial in-flow design, which present a much greater cross-sectional area to the incoming gases. These show a much improved back pressure performance, even after extended mileage, without detriment to filtering efficiency.

The developers claim that lead emissions can be reduced to lower overall levels, and much lower urban levels, than is attainable by any practicable reduction in lead-in-petrol which would not render current designs of engine obsolete. They also claim that, because of the need to obtain maximum life from the filter elements, long-life exhaust systems reduce the overall additional cost to perhaps zero, or at most the equivalent to about 1p per gallon of petrol.

Reader Enquiry Service No. 7553

"Air Knows No Frontiers"

INTERNATIONAL NEWS

SWEDEN

The International Water Conservancy Exhibition is being held from 1-5 September this year at Jonkoping, Sweden. It is organized together with experts from the National Swedish Environment Protection Board, the Federation of Swedish Industries, the Swedish Water and Air Pollution Research Laboratory, the Water Purification Group within the Association of Swedish Metalworking Industries, the Association for Water Hygiene, the Swedish Water and Sewerage Works Associations as well as organizations and institutions from abroad.

The exhibition and conference are aimed at Swedish and international experts representing public administration, architects, consultants, doctors, veterinary surgeons, health officials, researchers and industrialists.

The technical exhibition includes equipment and devices for sewerage purification plants, water purification plants, and sampling, measuring and laboratory equipment.

HOLLAND

Burning Refinery Wastes

A special task force of the Oil Companies' International Study Group for Conservation of Clean Air and Water in Western Europe (Stichting CONCAWE) has just issued a report on incineration of refinery wastes.

Approved sites for dumping these wastes are becoming scarce and strict controls are imposed by authorities. Incineration is therefore considered to be the more suitable alternative for a number of wastes and as incineration grows in the near future it becomes feasible that private companies or (semi-) government bodies will undertake this work.

Several entirely different techniques are required for the different types of waste depending on its source, for example from crude tanks, desalter bottoms, gravity separators, recovered oil tanks, flocculation, biological activation, etc.

Five different basic types of incinerators are available on the market, i.e. the rotary kiln type, multiple hearth, fluidized bed, a box furnace and vortex type incinerators are compared. The report also gives details of the nature of the wastes and techniques for disposal, particularly for waste oil, sludges containing lead, chemical sludges, oily solids and general wastes like paper, wood, rags and domestic refuse.

The CONCAWE report indicates that: "The incineration of oily sludges is expensive and needs considerable care and attention. Effort devoted to minimizing the quantities of oily sludges formed and needing incineration is well worthwhile. The most difficult to incinerate satisfactorily are those of high but variable oil content. The enormously increased value of fuel since most of the report was written emphasizes the need to attempt the recovery of the oil from such sludges by other means if at all possible."

The report 2/75, available free from Stichting CONCAWE, 60 Van Hogenhoucklaan, The Hague 2018, Netherlands, lists three tables, 13 illustrations and a bibliography containing 86 titles. Reproduction is permitted with due acknowledgment.

HONG KONG

London Consultancy Wins Hong Kong Contract

Environmental Resources Ltd., London (ERL), has been appointed by the Government of Hong Kong to assist in preparing comprehensive environmental legislation for the Colony.

ERL will collect and evaluate data on environmental pollution in Hong Kong, assist in the preparation of a general Environmental Protection Ordinance and draft legislation covering land, sea, air and noise pollution, and advise on the setting-up of a pollution control agency which will be the watchdog for the new legislation.

The consultancy's work is expected to take 18 months. An ERL project team representing legal, technical and economic disciplines returned from Hong Kong this week, following discussions of pollution problems with Government and Industry.

ERL has a wide experience of environmental control legislation and administration. The Company has recently completed a comprehensive study of environmental legislation and its enforcement in the nine EEC Member States, for the Commission of European Communities in Brussels. It has also carried out a wide range of studies for home and overseas government on environmental impact, and for a number of multi-national corporations on the effects of specific environmental contaminants.

According to Mr. Alan Armstrong-Wright, Hong Kong Deputy Secretary for the environment, "much of the existing legislation is not geared to conditions of dense population and traffic, and the intense industrial and agricultural development. In order to rectify this there is a need for overall environmental legislation to ensure that Hong Kong's industrial base can be broadened without detriment to the environment. For this reason, carefully formulated controls should be stipulated in legislation as soon as possible. To be effective, these controls will have to be practical and within the capacity of industry to introduce."

ERL is a research and planning group formed specially to provide comprehensive multi-disciplinary services to government, industry and international organisations seeking advice on environmental problems.

U.S.A.

A team headed by the Massachusetts Institute of Technology has been selected to conduct a design study for an experimental solar energy project on Citicorp Center, a 56-storey skyscraper under construction in New York City.

The National Science Foundation, which announced the project, has awarded M.I.T's Energy Laboratory $186,000 for the 12-month study.

The idea of using solar energy in the Citicorp building was initially proposed by Consolidated Edison Co. of New York in response to Citicorp's desire to incorporate energy conservation features in the building complex. After considering Con Edison's proposal, Citicorp commissioned Loring-Meckler Associates, a Washington D.C. consulting firm, to develop the idea further and at the same time change the design of the building's sloping tower so that it faced south for maximum exposure to the sun. All three companies are participating in the project.

The study, to determine if solar energy can economically operate a dehumidifier in an air-conditioning unit and save conventional fuels, will be carried out on the privately-owned Citicorp Center being constructed at Lexington Avenue and 53rd Street in mid-Manhattan.

Specifically, the M.I.T. researchers will seek to provide a technical and economic evaluation of solar energy dehumidification systems when used on a large scale in an urban environment.

The researchers also will try to provide the operational data and analysis necessary for applying the system to existing and proposed structures.

After completion of the design study, a proposal will be made for a full scale experiment at Citicorp Center.

The grant to M.I.T., made under NSF's RANN (Research Applied to National Needs) programme, will help researchers get data to compare the performance of a conventional air-conditioning unit with that of a conventional unit augmented by a chemical dehumidifier that is regenerated by heat from a solar collection and energy storage system. Both types of unit will be installed in the building.

A conventional air conditioning system dehumidifies incoming air by chilling it, often to temperatures below that desired in the occupied space. The chilled air then has to be reheated. Energy thus is needed not only to chill the air for removal of moisture, but also for reheating.

The project at Citicorp Center is based on a technique of removing moisture from the incoming air at or near the outside temperature by passing the air through a spray of concentrated liquid which strongly absorbs water. The dilute liquid can then be dried and reconcentrated by heating it to temperatures readily available from solar energy collectors. Components already developed and available will be used.

By using this system for dehumidification, significant chilling and reheat energies are saved. In addition, the regeneration energy that is required is obtained from the sun.

Preliminary studies of the system envisage a full-scale experiment on Citicorp Center with regeneration accomplished using heat from a solar collector mounted on the south-facing 45-degree sloping roof of the building.

Flat plate collectors with a total area up to 20,000 square feet—almost one half acre—will be mounted on the roof. A large water storage system will be provided in a mechanical space near the roof.

The solar system—providing side-by-side comparison with the conventional system—will take care of much of the dehumidification energy requirements for the upper 25 floors.

Preliminary studies indicate that the solar dehumidification system will achieve a 5% air conditioning energy savings for the building with a solar collector area which is small in relation to the total building surface area.

Surplus solar heat can be used to supplement the heating of hot water for the building.

The research team's work in the next six months will be concentrated on an analysis of solar dehumidification, selection of a final design for the system and on obtaining cost estimates from potential contractors for construction of the system. The following six months will be used to develop the operating plan for the experiment.

ZAMBIA

£400,000 Drying Plant for Zambia

A major export contract valued at £400,000 has been awarded to Buell Limited by Roan Consolidated Mines Limited, Zambia, to design, supply and install, a copper concentrate drying plant for their Luanshya Division.

The contract comprises a horizontal rotary drum dryer, four cyclone dust extractors and an electrostatic precipitator, the latter being built by Lodge-Cottrell (Buell is an associate company of Lodge-Cottrell).

The drum dryer, 10ft diameter and 100ft long, can process up to 100 tonnes per hour of concentrate together with lime rock flux. The dryer is externally heated by a pulverised fuel fired furnace.

The moisture laden exhaust gases are preheated prior to passing through the cyclone bank and the electrostatic precipitator in order to maintain their temperature above dew point.

CLEAN AIR SPRING SEMINAR, 1975

The Fourth Clean Air Spring Seminar was held at the Gosforth Park Hotel, Newcastle upon Tyne from 18th-20th March, 1975. The theme of the Seminar was Grit, Dust and Fume and to a large extent this was based on the work of the Department of the Environment's Second Working Party and its report on Grit and Dust Emissions.

Expectation and interest were obviously high since the Seminar received great support; so much so that the Society was repeatedly asked to extend the number of delegates who could be accepted. The final figure was 199.

The Seminar was opened by the Deputy Lord Mayor of Newcastle, Councillor Miss Steedman, who welcomed the delegates to the City. The first technical session proper was given a good start by Dr. G. G. Thurlow of the National Coal Board, who had been Chairman of the Working Party. Dr. Thurlow explained the general considerations with which the Working Party had had to contend and outlined the background of the report as a whole. This served to set the scene for what was to follow. Papers on the work of the various Panels then followed. Mr. G. Taylor of the Scientific Branch of the Greater London Council discussed the work of the Incineration Panel; Mr. F. M. Shaw of the British Cast Iron Research Association presented a paper written in conjunction with Mr. P. J. Moseley of Messrs. Stanton & Staveley (BSC) about the work of the Cold Blast Cupola Panel; and Mr. E. B. Briggs of BP Marketing Ltd presented a paper on the work of the Dryers and Miscellaneous Furnaces Panel.

At lunch time there was rather a scramble from those delegates who had not booked for technical visits, to obtain any vacant places. Great tact was needed by the staff dealing with this problem to try and please everybody. In the event, four parties of delegates visited American Air Filters Ltd, Associated Lead Manufacturers, the CEGB Stella South Power Station and the Municipal Incinerator at North Tyneside. The session on the Wednesday morning was opened by Mr. A. Keating of Airflow Developments Ltd who presented a paper on Instrumentation for Particulate Measurement. This was followed by a paper on the Need for Monitoring presented by Mr. A. Archer, the Chief Air Pollution and Noise abatement Officer of the City of Birmingham. After the interval, Mr. W. Short, from NIFES, discussed the Practical Experience on Measurement of Grit and Dust Emissions, and Mr. S. C. Wallin of Warren Spring Laboratory presented the paper written by himself and Mr. Clayton on Measurement and Standards for Pollutant Emissions from Stationary Sources.

More technical visits followed on the Wednesday afternoon, and these were again filled to capacity. Places visited were Alcan (UK) Ltd, the Municipal Incinerator at Gateshead, the NCB Coking Plant at Monkton and the Newcastle Polytechnic where demonstrations of research work being undertaken were given.

The attendance at the last session on Thursday morning was very large indeed which was extremely gratifying. Dr. Fuge, H.M. District Alkali and Clean Air Inspector started things off by discussing the specific problems of the control of grit, dust and fume. Mr. H. Westwood of Howden Engineering Ltd described grit arrestors, and the use of the electrostatic precipitator at high temperature was described by Mr. K. R. Parker of Lodge Cottrell Ltd, who presented the paper prepared by himself and Mr. K. Darby.

After the interval, Mr. H. A. Edwards of Nailsea Engineering Ltd talked of the use of bag filters for dust arrestment and Mr. Max Beaumont of Messrs. F. E. Beaumont Ltd explained a new device for the extraction of solids from the flue gas stream of oil-fired boilers. The final paper of the Seminar was presented by Mr. John Thurley of Messrs. John Thurley Ltd of Harrogate and he outlined the use of after-burning as a means of fume control.

This was undoubtedly a very full programme and it was clear from the lively discussion which took place at each session that delegates were extremely interested and not only learned something from the papers but were able to contribute much to the success of the Seminar as a whole.

The technical visits obviously were much more popular than they had been in previous years and the rush at the last minute to secure places was entirely unexpected. However, it is gratifying to know that such visits are appreciated and they will undoubtedly form an important feature in future seminars. We would hope however, that in future, delegates will retain the forms with which they are provided and on which they can state their choice of visit, early.

On the social side, we are very much indebted to the Lord Mayor of Newcastle, Councillor Mrs. Collins, who so kindly entertained all delegates to an excellent cocktail party in the Mansion House on the Tuesday evening.

OBITUARY

We very much regret to learn of the death, early in March, of Mr. James Parker of the Air Pollution Division of the Warren Spring Laboratory.

Mr. Parker was well known to many members of the Society. He will be remembered as a speaker at Clean Air conferences.

His work in the field of air pollution over the last twenty-eight years brought him into contact with many local authorities and private citizens whom he helped with their problems. In particular, he became expert in identifying the sources of various nuisances which were otherwise difficult to attribute to specific operations or installations. He made a special study of airport pollution and was a valuable representative of the British Standards Institution on various sub-committees of the International Standards Organisation.

AIR POLLUTION ABSTRACTS

Papers presented to the NSCA Fourth Spring Seminar, Newcastle upon Tyne, 18-20 March 1975.

1340 General Considerations. Dr. G. G. Thurlow, National Coal Board, Chairman of the Working Party.

This paper discusses the problems facing the Working Party in reaching their decisions. Dr. Thurlow points out that when deciding a limit to place on the emission of any pollutant, the result is necessarily an arbitrary one. The decisions were made by discussion among experts who feel they are reasonable, consistent and realisable. The approach taken was simple and pragmatic to avoid philosophical argument. Various aspects of the formulation of the recommendations are discussed in detail.

1341 The Work of the Incineration Panel. G. Taylor, Scientific Branch, Greater London Council.

The terms of reference given to the Working Party by the Department of the Environment in relation to incinerators, were the same as those for the dryers, miscellaneous furnaces, and cold blast cupolas, and were as follows: ' To advise on the levels of emission admissible under Section 2 of the Clean Air Act 1968 '. The report of the first Working Party under the Chairmanship of Mr. D. Dicks, published in 1967, formed the basis of ' The Clean Air (Emission of Grit and Dust from Furnaces) Regulations: Statutory Instrument 1971 No. 162 '. It is hoped that the findings of the Second Working Party will result in similar regulations.

In this paper the Author reports on the methods employed by the Panel in determining standards by which to carry out the examination.

For plant with a capacity greater than 50 M Btu/h, a limitation of the rate of solids emitted equivalent to 0·1 gr/ft^3 at NTP, 10 per cent CO_2 has been recommended by the Panel and endorsed by the Working Party as a whole. This is a more exacting standard than that which can be derived by analogy with indirect and heating furnaces in the earlier Hicks report of 1967. It can be argued therefore that it embodies the improvements in standards possible with the application of up-to-date cleaning technology. In the appendices the Author lists the existing legislation relating to incinerator emissions and gives tables showing relevant data.

1342 The Work of the Cold Blast Cupola Panel. P. J. Moseley, Stanton and Staveley (BSC) and F. M. Shaw, British Cast Iron Research Association.

The Authors briefly discuss, with the use of tables and diagrams, the results and limitations of the first Working Party; and the conclusions of the second Working Party that relate to Cold Blast Cupolas.

In 1972 the Second Grit and Dust Working Party was set up and charged with making recommendations for emission limits for those furnaces for which the Hicks Committee felt unable to make suggestions. The most difficult proved to be the Cold Blast Cupola and the Working Party formed a Cold Blast Cupola Panel.

Following a comprehensive survey, the Panel considered the results which showed that over 70 per cent of the country's molten iron requirements, some 3·75 million tons come from Cold Blast Cupolas.

The sampling method used by the Panel in compiling the recommendations was a BCURA cyclone sampler as described in BS 3405. The recommended allowable emissions of grit and dust which were accepted by the Working Party are given as pounds per hour and relate directly to the capacity of the cupola.

1343 The Work of the Dryers and Miscellaneous Furnaces Panel. E. B. Briggs, C.Eng., M.I.GasE., F.Inst.F., F.Inst.Pet., Senior Engineer, Industrial Fuels, B.P. Marketing Limited.

The terms of reference for the Second Working Party on Grit and Dust Emissions, set up in March 1972 were: ' To advise on the levels of emission admissible under Section 2 of the Clean Air Act 1968 in relation to incinerators and to furnaces where the material being heated contributes to the emission '. The views and recommendations of the Dryers and Miscellaneous Furnaces Panel, established by the Working Party, are outlined in Appendix 3 of the ' Thurlow Report '.

This paper outlines several features included in the Panel's deliberations and adds occasional comment or suggestion. The Panel reviewed the historical developments since the Hicks Report, particularly with respect to the performance of arrestment plant and general industrial experience with various types and designs of equipment. The need for consistent day-to-day performance over long periods featured largely in review.

A scenario of tentative limit values for a range of furnaces and conditions was progressively developed. The final values resulted in the table given in the paper. The Panel specify that grit in the emission should not exceed 20 per cent of the allowable emission of grit and dust.

MONITORING

1344 Instrumentation for Particulate Measurement. A. Keating, Airflow Developments Limited.

The Introduction to this paper summarizes the increasing attention being given to all environmental matters. Although all forms of pollution are destructive, air pollution is possibly the most significant, having a more direct and discernable effect. The author points out that our entry into the E.E.C. will mean tighter pollution legislation, which is currently at discussion stage. The Control of Pollution Act 1974 is seen to provide a boost to sampling, monitoring and control equipment demand, since it gives Local Authorities powers to enter industrial establishments for the purpose of carrying out dust sampling tests.

The areas of control determined by both past and present law are then discussed, including the British Standards Institute document of 1961—to provide standards for equipment and procedure for determining dust and grit emissions.

Thus, in order to keep a constant check on pollution levels, efficient and well designed instrumentation is required. Devices manufactured by Airflow Developments Limited have become accepted as the standard equipment for determining grit and dust emission, both in Great Britain and abroad.

The paper continues by describing particular types of equipment and the jobs they do in detail, including a description of their operation principles. A conclusion is drawn by stressing that it is upon well designed testing equipment that we are ecologically dependent.

1345 The Need for Monitoring. A. Archer, F.E.H.A., City of Birmingham, Chief Air Pollution and Noise Abatement Officer.

Air pollution control activities must form part of a well designed and effective monitoring system. In every Local Authority area facts on the type, rate and source of emissions are essential. With new legislation on permissible emission limits for a wider range of furnaces than at present covered, inplant monitoring of certain equipment must supplement the present area monitoring. Because frequently, it is unsuitable equipment checked only when faulty, that is to blame, there is a great need for close collaboration between factory inspector and Environmental Health Officer. A real impact will be made, according to the author, when Local Authorities appoint sufficiently skilled staff to provide regular and detailed inspection of factories.

A Scientific Advisory Committee on Environmental Pollution has been established in Birmingham to advise on monitoring methods and the interpretation of the collected data. An outline of the two year research into airborne lead at the Gravelly Hill interchange by Dr. J. Butler is examined, together with the heavy metal survey undertaken by the Environmental Protection Unit of Birmingham. It is all very well monitoring the many pollutants but have we the necessary trained technical staff to interpret and implement the information as it becomes available so that correct and proper use can be made of the control equipment?

1346 Practical Experience on Measurement of Grit and Dust Emissions. W. Short, B.Sc., C.Eng., F.Inst.F., F.I.H.V.E., F.I.Nuc.E. National Industrial Fuel Efficiency Service Limited.

The grit and dust measurements were carried out using the B.C.U.R.A. cyclone and filter system. This uses a small cyclone which collects a flue gas sample through a sharp-edged inlet nozzle and separates the majority of the grit and dust. This then passes into a detachable hopper which can be weighed before and after the test. If there is a lot of very fine dust, the cyclone can be backed up by a filter system which removes this fine material. Sampling has to be isokinetic, using a pilot tube first to establish the pattern of gas velocities in the flue. British Standard 3405: 1971 describes the typical requirements for suitable apparatus and also discusses sampling methods in some detail. NIFES have four complete B.C.U.R.A. sets in use at present By 1975 they had carried out tests at over 700 firms and something like 2,000 test runs.

The author discusses problems which occurred with the equipment, under the headings of Temperature, Small Ducts, Mechanical Breakdown, and Moisture. In his final comments he stresses that there is not much point in Local Authorities asking for, or in firms carrying out, expensive measurements of grit and dust emission rates if the plant is badly operated or poorly maintained.

1347 Measurement and Standards for Pollutant Emissions from Stationary Sources. S. C. Wallin and P. Clayton. Department of Industry, Warren Spring Laboratory.

This paper, with the use of extensive tables, deals with the wide range of instrumentation currently available to measure pollutants from stationary sources. It points out that to obtain reliable data, it is often necessary to develop combined systems of sampling and measurement. Consideration is given to the measurement and recording of particulates and gases felt to be the principle pollutants in relation to currently available instrumentation. However, some thought is given to future developments in continuous monitoring.

The Authors discuss each of the following essential steps of measurement of emissions in turn: Selection of Sampling Position, Sample Extraction and Treatment, Sample Analysis, and Data Interpretation and Standards.

It is recognised that manual methods of measurement can be time consuming and provide an incomplete record of emissions. Continuous monitoring instrument systems must be developed with the desirable attributes —reliability, minimum maintenance and low cost.

CONTROL OF GRIT, DUST AND FUME

1348 Specific Problems. Dr. E. T. J. Fuge, H.M. District Alkali and Clean Air Inspector.

The Author initially refers to the "best practicable means" requirement written into the Alkali Acts, which he states has afforded a control measure proven to be effective in protecting the public and, equally important, acceptable to both industrial management and the control agency. "The concept is the fundamental and operating principles of the legislation controlling pollution of the atmosphere in Great Britain."

The basic elements for good control discused in this paper are: :

a. The setting of standards of emission and/or other requirements.
b. The use of dispersion which relates residual emissions to environmental effects.
c. Prior approval of equipment.
d. Routine inspection.
e. Legal action against blatant malpractices.

All these elements are contained in "best practicable means" and form the legal basis for any control system.

1349 Grit Arrestors. H. Westwood, Howden Engineering Limited.

Except for plants on which the installation equipment for collection of grit and dust performs an essential function in the manufacture of a product, the main incentive for installing such equipment usually stems from public pressure and the Clean Air Act.

The means for controlling the emission of grit and dust can be broadly divided into five classes: Settling Chambers; Bag Filters; Electro Precipitators; Washers or Scrubbers; and Mechanical collectors or grit arrestors.

In his paper the Author explains, with the aid of diagrams, the principles of operation of various types of equipment within the above categories. It is pointed out that in selecting equipment suitable for a particular application, in addition to the other considerations, the economics of the selection are also taken into account.

1350 The Electrostatic Precipitator at High Temperature. K. Darby and K. R. Parker. Lodge-Cottrell Limited.

With the use of extensive diagrams and tables, the Authors consider that electrostatic precipitators take over from fabric filtration methods at high temperatures.

Where high efficiency collection is required, the electrostatic precipitator has been proved successfully in numerous circumstances, ie: municipal incinerators, lime kilns, alumina and magnesia calcination, iron, nickel and copper refining, and various chemical process plants. Typical examples of these applications are given in the paper, together with their respective test results.

The paper also describes the various factors which affect the design and sizing of the precipitator in relation to the fundamental equations; and finally the economics of hot side electrostatic precipitators versus cold side applications are considered where it is possible to operate at either temperature.

1351 Bag Filters for Dust Arrestment. H. A. Edwards, Nailsea Engineering Co. Ltd.

Diagrams and tables are used to exemplify the points contained in this paper. The introduction points out that the restricted possible uses of bag filters available at the beginning of the century no longer applies. In the last decade the fibrous materials for gas filtration have proved an efficiency of separation not readily available by other means. A summary of the history of bag filters is included, following their stages of development.

The Author deals at some length with the original and development of the so-called reverse pulse filter. This type now accounts for over 50% of bag filters installed throughout the world, compared with shaking and reverse flow types. It is now possible to select suitable filter media to deal with most known applications for dust arrestment, with variable temperature ions and chemical considerations. There are detailed explanations of the relative merits of the different fabrics, natural and manmade.

Principles are given of the theory of the mechanism for particle arrestment by fibrous filter media. Successful application of fabric filters depends not on their detailed filter design but on the correct choice of filter media, and particularly on choice of air to cloth ratio or velocity through the cloth.

It is now possible to extend the future scope of bag filters in the field of dust arrestment, (temperatures up to 350°C can now be reached at a realistic cost). The chemical, mineral, iron and steel, and food industries have all proved the application of bag filters. It is suggested now that, regarding incinerators, the latest high temperature filtration techniques are worthy of consideration. Likewise application to dryers and furnaces is increasing. However, thorough understanding, careful design and selection are essential for success.

1352 Extraction of Solids from the Flue Gas Stream of Oil Fired Boilers. Max Beaumont, M.Inst.F., C.I.G.Tech E. Managing Director, Messrs. F. E. Beaumont Limited.

It is now a well-known fact that smut emission from oil-fired plant and chimney corrosion can be avoided if chimneys are correctly operationally designed and insulated. Subsequently, it has been found that it is advantageous to use a multi-flue chimney if more than one boiler is used.

However, there is still a pollution problem which is caused by the emission of ‘stack solids’.

In view of impending legislation, the technical services branch of B.P. began carrying out a research programme in 1971, to investigate feasibility of removing the solids from the gas stream.

The limit was finally fixed at 0·4% in the U.K., a figure which was considered an achievable level by the U.K. legislation. However, many plants have difficulty in achieving this figure and it was to these plants that the research was directed.

B.P. contacted F. E. Beaumont Ltd. with a view to joint development and marketing of a solids collector, and this paper describes the research and various stages of development which preceded the final production of the Beauvent Gas Solids Collector.

1353 After-Burning as a Means of Fume Incineration. J. Thurley, John Thurley Limited.

This paper discusses pollution by means of after burning, a technique which can be applied to solid wastes, fumes, liquids, and gases.

It deals initially with solid waste incineration with both pyrolysis and partial combustion methods. Secondly, fume incineration both by burner incineration and thermal oxidation are explained.

Finally, the paper, which is accompanied by diagrams, discusses heat recovery which can be applied to all the systems included. All these heat recovery systems tend to be of the convective heat transfer type, due to the relatively low temperture of the combustion products after incineration. They can be combined to meet the requirements of steam generation, space heating, process heating, or building replacement air heating.

Papers available at 50p each + p. & p.

Letter to the Editor

Dear Sir,

In the conclusions to their paper ‘Air Pollution in Europe and the Fuel Shortage’ reproduced in the Spring Issue, the authors point out that there is no justification for introducing into Europe the stringent controls that are proposed for America; but they add that it is unrealistic to expect that action will rest solely on scientific evidence in view of the public concern over pollution.

I believe that much of the public pressure arises from publicity given to the Los Angeles smog by sincere but often inadequately informed persons who sometimes give the impression that this may occur in this country if drastic measures are not taken.

In the early part of the paper the authors point out not only that the Los Angeles conditions do not exist in Europe, but also that the State of California alone consumes annually more petrol than Great Britain and West Germany together. Can the authors give figures for annual petrol consumption for Los Angeles, San Francisco (which does not I understand suffer from the Los Angeles smog) and London—with their commuter belts? Such figures would, I suggest, dispose of the unjustified fears of many and hopefully result in a more rational appoach to future proposals in this country for the control of pollution by motor vehicles.

Yours faithfully,

E. R. Watkins
The Coach House
Chardstock
Axminster
Devon

The Incineration of Waste Liquids and Solids

by

J. I. Morris

This paper was presented to a meeting of the Yorkshire Division, held at the works of John Thurley Ltd. at Harrogate on 5th March 1975.

Waste liquids

The basic requirements of a waste liquid incinerator are similar to those outlined previously for fume incinerators.

It is necessary to mix the waste liquid with an adequate supply of oxygen, usually in the form of an air stream, to raise the temperature of the mixture to a point at which oxidation will take place, and to maintain the mixture at this temperature for sufficient time for the oxidation reaction to be completed.

Waste liquids are normally injected into incinerator chambers through atomising nozzles. These nozzles may be pressure atomising, or may use a supplementary atomising fluid such as steam or compressed air. The nozzle has two main functions, it breaks down the liquid stream into small droplets which will vaporise rapidly, and it distributes the resultant spray uniformly within the incinerator chamber. The shape and size of the spray formed by the atomising nozzle must suit the incinerator combustion chamber dimensions, and great care should be taken when selecting suitable nozzles.

Many liquid wastes are extremely difficult materials to handle, they may be highly corrosive, or highly viscous and require pre-heating before atomising, and they very often contain large proportions of suspended solid particles. Very often the composition of the waste can vary quite widely, and it is useful to provide storage tanks fitted with mixing equipment, to give some degree of averaging of composition.

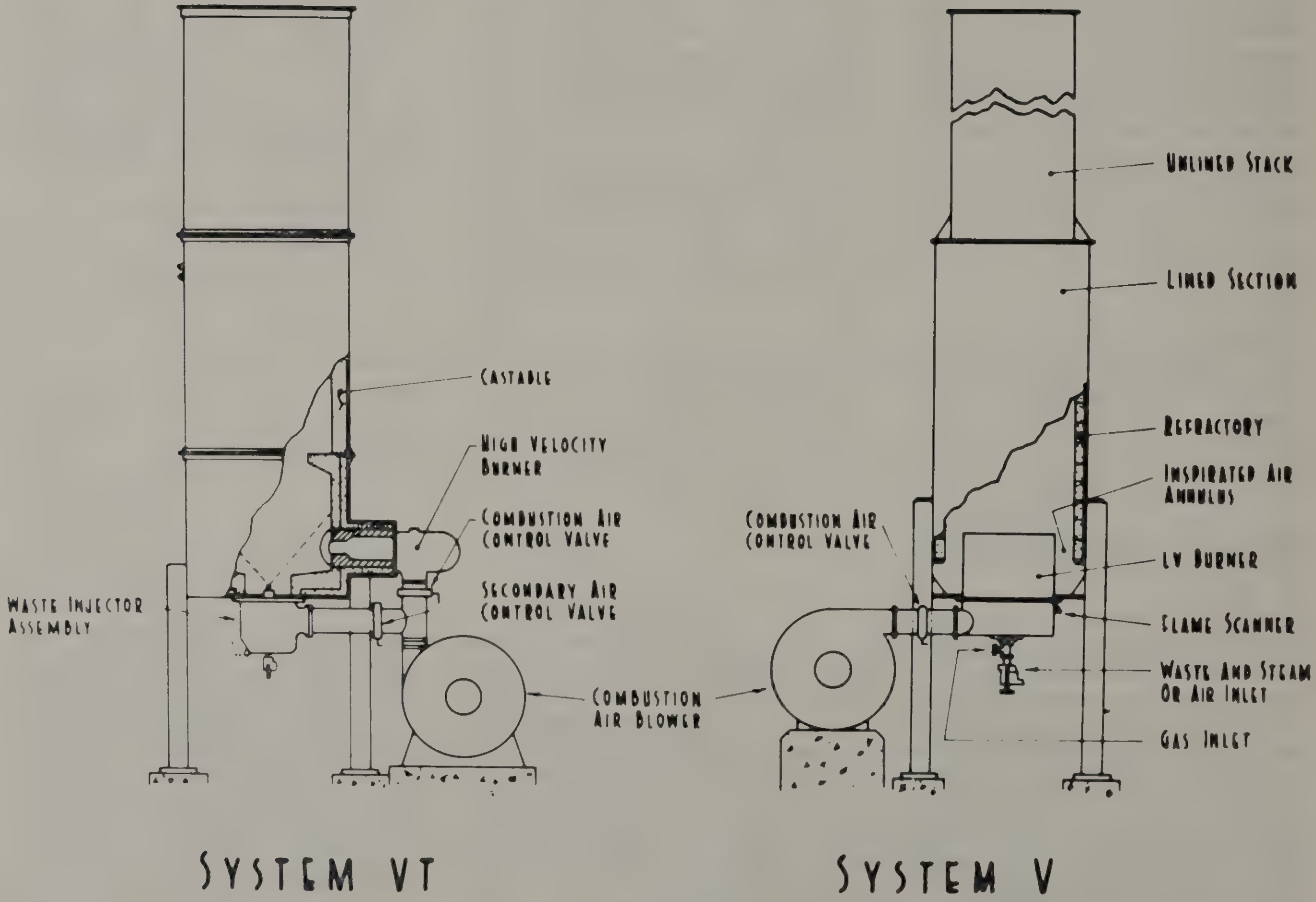


Fig. 1 *These diagrams illustrate the two basic types of incinerator for liquid wastes. The VT system is used for low calorific value wastes which are injected through the atomising assembly at the base of the unit. Heat for incineration is provided by the tangentially firing burner on the side of the unit. The V system is used for high calorific value wastes which are burned in the high intensity burner, possibly with the addition of supplementary fuel*

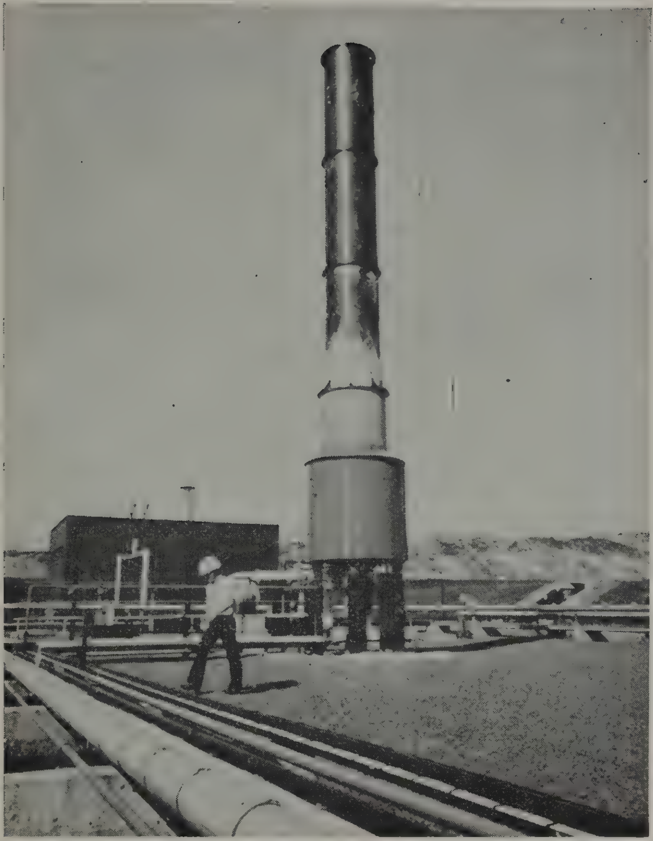


Fig. 2 *This liquid incinerator is installed on a natural gas liquefaction and storage facility. It is designed to incinerate heavy ends and aqueous wastes contaminated with hydrocarbons*

Liquid wastes can be conveniently divided into two types, on the basis of calorific value there are high calorific valve wastes, which are capable of being burned directly in a burner possibly with the addition of small quantities of auxiliary fuel, and low calorific valve wastes which cannot be incinerated through a burner, and require large quantities of auxiliary fuel.

The two basic types of incinerator for these wastes are shown on the diagram.

The type V Liqui-Dator is used for high calorific value wastes, and consists of a high intensity Vortex burner, in which the waste is burned, firing into a refractory lined cylindrical chamber. Secondary air is either drawn into this chamber by natural draught or may be blown in from a forced draught fan. The temperature within the refractory lined chamber is maintained at about 900°C, to ensure that oxidation is completed before the exhaust gases are cooled on leaving the stack.

The type VT Liqui-Dator is used for low calorific value wastes, typically aqueous wastes containing very small proportions of organic impurities. The waste liquid is injected into the base of the incinerator chamber, together with a secondary air stream. This air stream assists in atomising the liquid, and also provides the oxygen necessary for incineration. The heat for incineration is provided by a burner firing tangentially into the incinerator chamber, at high velocity, giving good turbulence and mixing inside the incinerator. The throat or restriction above the supplementary fuel burner serves two purposes, it helps in mixing the gases, by compressing and then expanding them as they rise through the chamber, and it serves as a stabiliser in the event of the organic content of the liquid wastes rising to a point at which a flame is produced. Without such a stabiliser the flame would rise up the incinerator and stabilise at the top, possibly resulting in the formation of smoke, but certainly resulting in partially oxidised gases escaping to atmosphere.

Many liquid wastes contain elements which produce toxic gases as a result of incineration, and the exhaust gases must therefore be treated before venting to atmosphere. A very common problem is that of chlorinated hydrocarbon wastes, and method which has been used to incinerate these wastes is the Sub-X process, shown on the diagram. The waste liquid is burned, possibly with auxiliary fuel, in a down-firing Vortex burner. There is a large secondary combustion chamber, down which the incinerated fumes travel prior to passing through the downcomer into the water bath. The chlorine in the waste is reacted with hydrogen, either in the waste, or from the auxiliary fuel, and the resulting hydrogen chloride is dissolved in the water bath. Make up water is sprayed into the water bath, to scrub out any last remnants of hydrogen chloride, and to keep the downcomer metalwork cool. Obviously great care must be taken in the selection of materials of construction, we have normally used rubber-lined mild steel tanks, lined with acid resisting brick, Hastelloy for the downcomer. The photograph shows a typical plant of this type being assembled in our workshop prior to shipment to Rumania.

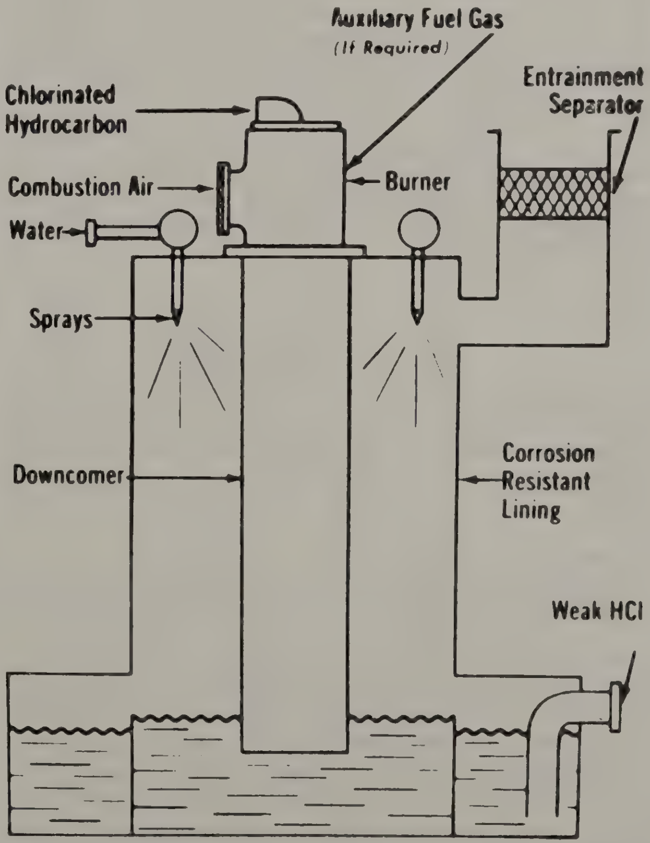


Fig. 3 *Principle of a submerged combustion incinerator for chlorinated hydrocarbons. The waste is burned in the high intensity burner where the chlorine is combined with hydrogen. The hydrogen chloride is scrubbed from the products of combustion as they leave the downcomer and bubble through the water bath*

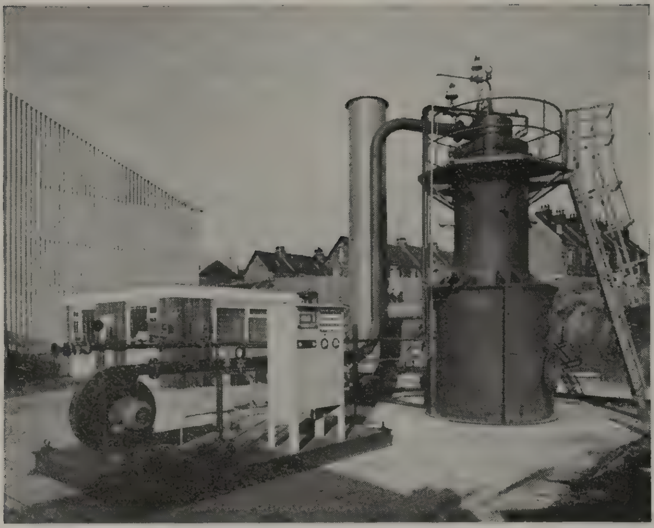


Fig. 4 *Submerged combustion incinerator for chlorinated hydrocarbon wastes pre-assembled before shipment to Rumania*

Solid wastes

If we bear in mind the basic design parameters for fume and liquid incinerators, the problems of handling solid wastes can easily be seen. It is not practical to pulverize and spray the solid waste into an incinerator, and therefore mixing must be achieved by blowing a combustion air stream through or over the waste. Contact time between the air stream and the waste is obviously extremely short, and the necessary air velocity can result in a large carry over of fly ash. This problem is made worse by the fact that many solid wastes have a large ash content. In most cases, an adequate temperature for incineration can usually be obtained, because most solid wastes have high calorific values. In fact problems are more often caused by the generation of very high temperatures within the waste bed, causing slagging of the ash and severe overheating of the incinerator structure.

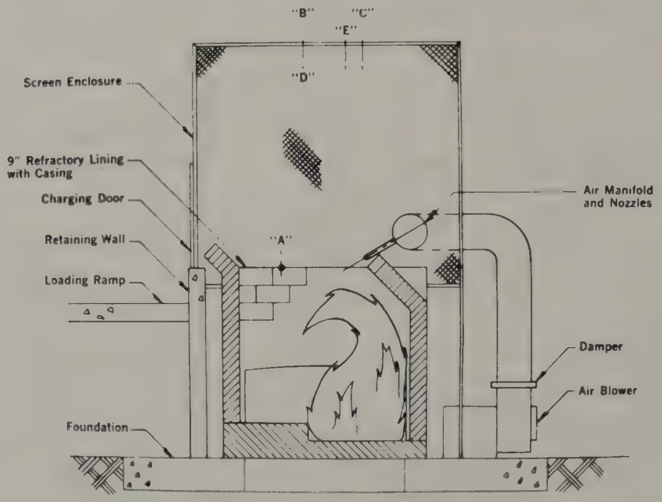


Fig. 5 *This diagram illustrates an early design of solid waste incinerator. The top is open to allow heat to radiate away and reduce the temperature in the incinerator. The angled air injectors produce a vortex action where products of combustion are recycled through the incinerator to give improved oxidation of the exhaust gases*

The Pit Incinerator was an early attempt to avoid the problem of overheating, and at the same time to improve the degree of oxidation of the exhaust gases. As can be seen in the diagram, this unit consists of an open-topped refractory lined box or pit. The open structure allows large quantities of heat to escape by radiation from the bed. The combustion air is blown into the pit through a series of nozzles located along one side of the top of the pit, and angled downwards into it. The resultant air flow is in the form of a vortex where the products of combustion are re-circulated back over the bed several times, giving an increased residence time and improved quality of incineration. The main drawback to this design is its tendency to produce large amounts of fly ash, and, on wastes with high ash contents, such as municipal wastes, slagging can still take place in the bed, giving rise to clinker formation and its associated maintenance and disposal problems. However, with wastes having a high calorific value, and low ash content, such as plastic wastes, then this unit can give satisfactory performance with an absolute minimum of capital expenditure.

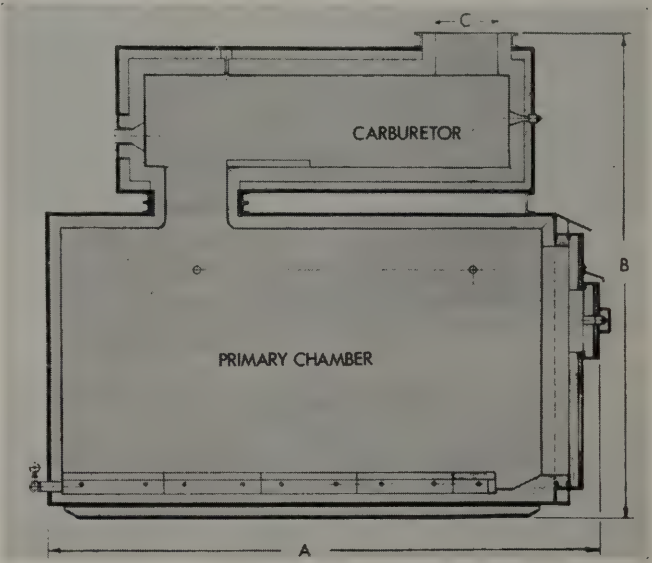


Fig. 6 *This diagram shows the basic construction of the Trecor incinerator. Solid waste is loaded into the primary chamber during the working day. At the start of the incineration cycle, the loading doors are closed and the waste ignited by means of a small burner. The waste is burned with a deficiency of oxygen and the resulting combustible gases are burned in the carburettor by the injection of secondary air, with additional heat from an auxiliary burner.*

The Trecor Incinerator has been designed to avoid the formation of fly ash by keeping air velocities low within the incinerator, and avoids the problems of overheating and slag formation by a process of slow combustion, with a very low air flow into the primary chamber. The heat from waste burning in the primary chamber dries off combustible gases from the remainder of the waste by a process similar to propolysis. The resultant stream of combustible gases are then incinerated in the secondary chamber or carburettor. This type of unit is particularly suited to applications such as hospitals or factories where small-scale incineration is economic. The incinerator cycle is automated, and waste is normally tipped into the incinerator during the day, for incineration during the night and there is normally no need for waste storage in addition to the incinerator.

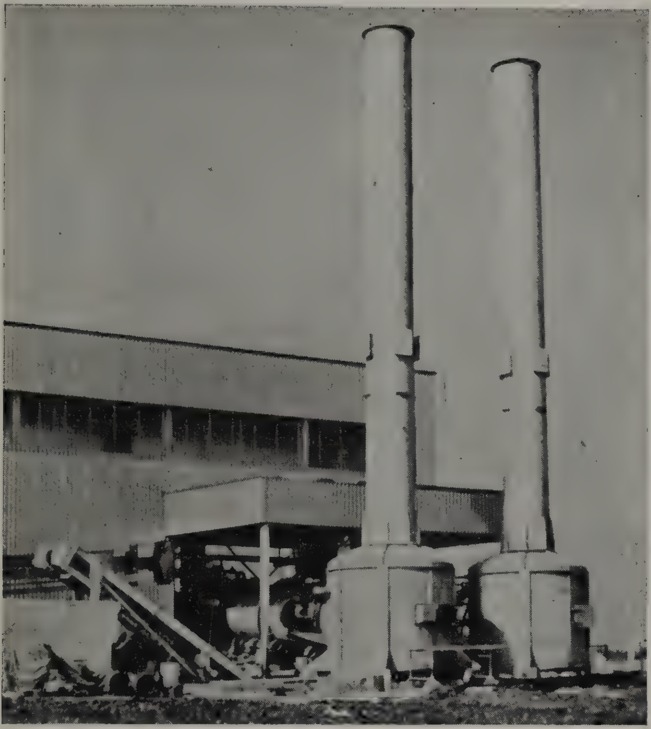


Fig. 7 *An installation of two rotary incinerators designed to dispose of 8 tons per hour of municipal waste together with liquid industrial wastes*

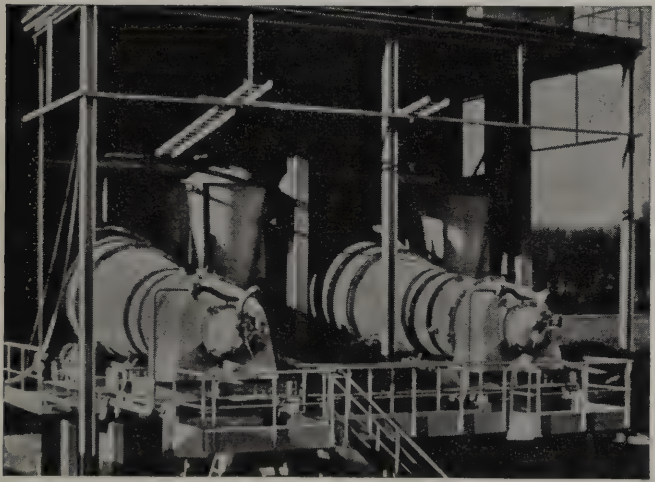


Fig 8 *An installation of two rotary incinerators designed to dispose of 12 tons per hour of municipal waste*

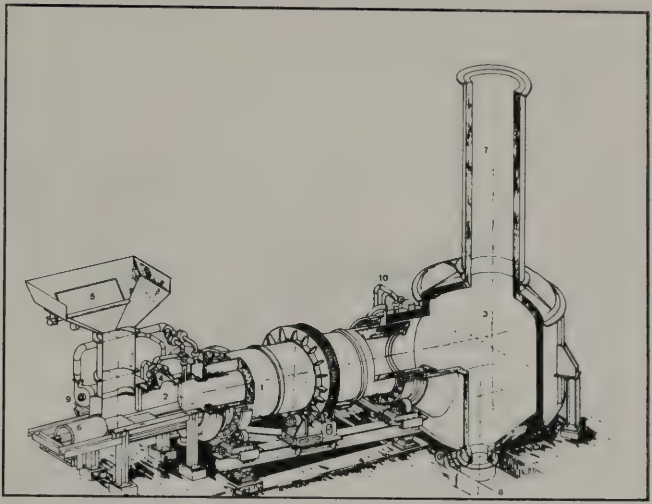


Fig. 9 *Incinerator Type OM Rotary Cylindrical*

Key

1—Rotary Combustion Chamber
2—Fixed Pre-Combustion Chamber
3—Cyclonic Post Combustion Chamber
4—Auxiliary Fuel Burner
5—Waste Feed Hopper
6—Waste Feed Hydraulic Ram
7—Stack
8—Ash Extraction System
9—Primary Combustion Air Fan
10—Secondary Combustion Air Fan

Model	Capacity kg/hr	Overall dimensions metres	Power consumption h.p.	Weight tonnes
OM 15	1500	14×5·50	80	92
OM 20	2000	18×6	80	98
OM 30	3000	20×7	100	—
OM 40	4000	25×8	120	—

Note: Capacity is based on a waste having a calorific value of 2,000 Kcal/kg, and will be different for wastes having different calorific values

Both the Pit Incinerator and the Trecor have the drawback of being intermittent in operation, and are therefore only suitable for small-scale operations. A principle which allows for continuous operation at relatively large capacities is based on the rotary furnace, and the diagrams show two types of unit which use this basic principle. In the rotary incinerator, the rotating furnace acts as a primary chamber, where combustion takes place with a low air flow, and therefore at low temperatures, to avoid slagging. The combustible gases produced leave the rotary furnace at about 800-1000°C and are oxidised by the controlled admission of secondary air, before the gases pass into the cyclonal post combustion chamber. This chamber serves to give a long residence time, ensuring full oxidation of the fumes, and also enables some of the fly ash to drop out of the exhaust stream.

The type FR incinerator uses a counter current flow of combustion air and solid waste, and is particularly suited to lower calorific value wastes such as some municipal wastes. The O.M. incinerator uses a co-corrent flow principle, and is therefore suited to high calorific value wastes such as industrial wastes or certain dry high calorific value municipal wastes.

This brief description can only set out some of the basic problems, and possible solutions to them. In practice, every incineration problem must be carefully considered and equipment designed to suit the particular requirements, including scrubbing or dust-removing plant, and heat recovery equipment where appropriate.

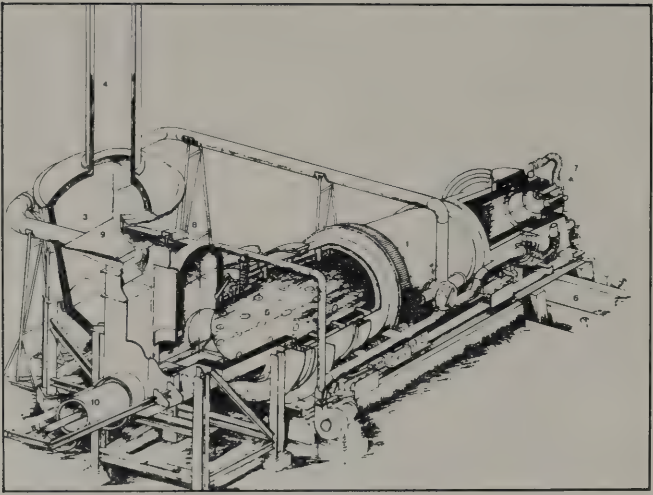


Fig. 10 *Incinerator Type FR Rotary Conical*

Key

- *1—Rotary Combustion Chamber*
- *2—Fixed Pre-Combustion Chamber*
- *3—Cyclonic Post Combustion Chamber*
- *4—Outlet to Exhaust Fan*
- *5—Primary Air Nozzles*
- *6—Ash Extraction Through Water Trough*
- *7—Auxiliary Fuel Burner*
- *8—Secondary Air Diffuser*
- *9—Waste Feed Hopper*
- *10—Waste Feed Hydraulic Ram*
- *11—Combustion Air Blower*

Model	Capacity kg/hr	Overall dimensions metres	Installed power consumption horse power	Water consumption litres/hr	Installed weight tonnes
FR 15	1500	12×6	140	400	55
FR 32	3000	13×6.5	240	500	68
FR 50	5000	14×7.5	335	1000	87

Note: Capacity is based on a municipal waste having a calorific value of 1,400 Kcal/kg. and will be different for wastes having different calorific values

Multi-Industry Approach by Filtration Conference

Users, research workers and manufacturers will be among the speakers from 12 countries who will present papers on many aspects of "Filtration and Separation—the Multi-Industry Technology" at the biennial conference of the Filtration Society taking place at Olympia, London, from 16-18 September, in conjunction with FILTECH/75 and the Dust Control and Air Cleaning Exhibitions (16-19 September).

The wide scope of the subject in both liquid/solid separation and dust control and air cleaning is shown by just three of the papers to be given.

Newsprint as an economical filtration medium for wastewater will be described by a speaker from America, J. M. Stauffer of Technical Fabricators, New Jersey.

Practical solutions to the fertilizer industry's dust collection problems will be offered by J. Remillieux of Prat Daniel, France, and W. T. W. Cory (Tam Air Industrie (UK) Ltd).

From the world-famous Dublin company of Arthur Guinness & Co will be coming E. A. Conway to describe how filtration and separation are used in brewing.

Papers on technological developments will include speakers from the Illinois Institute of Technology in Chicago describing a new fabric filter for asbestos dust, whilst the magnetic treatment of steel effluents will be dealt with by E. S. Twichell of Eriez Magnetic.

All the papers concerned with dust control and air cleaning will be given from 10 a.m. to 12.30 p.m. each morning and the sessions dealing with liquid/solid separation will be held each afternoon from 2 p.m. to 4.30 p.m. leaving part of each day for delegates to visit the associated exhibitions, which will include a stand from NSCA.

The registration fee for each conference is £15 for members of the Filtration Society and £25 for non-members. Delegates can attend both conferences for a fee of £20 for members and £30 for non-members.

Full details of the conference can be obtained from W. G. Norris, Hon. Secretary, The Filtration Society, 1 Katharine Street, Croydon CR9 1LB, England.

BOOK REVIEWS

Combustion, Formation and Emission of Trace Species

by John B. Edwards. Published by Ann Arbor Science Inc. Price £10·80.

Time was, not so long ago, when the combustion process was illustrated quite simply by

Carbon + Oxygen dioxide + heat

or, if combustion was incomplete by

Carbon + limited Oxygen = Carbon monoxide + less heat.

The fact that the oxygen in commercial applications was obtained from the atmosphere was important only in regard to the diluting effects of the large volume of nitrogen which was needed to be handled by the combustion system. This nitrogen was stated to be ‘ inert ’ gas because it was considered to take no part in the desired reaction which was conducted primarily to generate heat in boilers or furnaces.

This generation of heat was often carried out under conditions where carbon monoxide was formed and the main indicator of this condition was smoke emission, often on the grand scale. Dark smoke can therefore be regarded as the first ‘ trace species ’ of the combustion reaction and its elimination was a great victory in the fight for clean air.

The clean air campaign, by its very nature, involved many people of varied interests and who were not basically trained in combustion engineering. The wide interest in the protection of the environment has continued to involve more people, both amateur and professional and a great awareness of the complicated nature of the combustion process is apparent but comparatively few people have the opportunity to study the subject in depth.

Local Government reorganisations have brought to the fore the importance of the Environmental Officer and his staff who must, of necessity, have been trained in various disciplines but who must be able to understand each other's problems if a concerted attack is to be made upon those aspects of modern living which threaten the environment.

Since the elimination of black smoke from the chimney top, the dangers of sulphur dioxide have been recognised. The harmful effects of nitrogen compounds have been identified and are commonly discussed particularly in regard to automobile exhaust pollution. It is ironic that the nitrogen gas, hitherto considered to be ‘ inert ’, is now known to be a most insidious and dangerous pollutant. NO, NO_2 and NOx are read about even in the popular press but outside the professional field little is known of their formation and effects.

In other fields, ‘ pyrolysis ’ has become the ‘ in word ’ of the day and, here again, little is known of this process by many people who use the term so freely and who think that it has ‘ something to do with a process for incineration of refuse ’.

The Author of this book has tried to present the basics of the subject in a form which can be appreciated by those whose knowledge of chemistry is limited and, at the same time, he has examined the more complicated reactions and their mathematics for the more informed reader. He is at pains to emphasise at the outset that the subjects covered in this book are concerned with only one aspect of the broad spectrum of the combustion of materials. Nevertheless, it is most important in that the trace elements from combustion processes are now causing ‘ photosynthetic smogs ’ in many parts of the world. Investigation into causes of these smogs is concerned with the examination of minute concentrations of mixtures of complicated chemicals. Having found the cause it is the responsibility of the combustion engineer to design and operate systems with minimum emissions.

The different types of flame construction are explained from pre-mixing through to post-flame reactions with pyrolytic effects being emphasised in terms of the formation of particulates and trace compounds. The effects of ‘ additives ’ are discussed, along with the relationship between combustion intensity and pollutant formation.

The important effects of particulates on the heat exchange surface and combustion chamber lining is of interest to those who are experiencing corrosion, degradation or ‘ build-up ’ troubles in combustion plant. Operations of modern municipal refuse incinerators will find this to be of particular interest.

Thorough treatment is given to secondary combustion processes in terms of thermal reactors and after burners. At the present time great interest is expressed on all sides in the reduction of deleterious compounds from motor car exhausts and, as can be expected from one who is so closely connected with the automobile industry, the Author has dealt with this subject at length. This section of the work should be read by all those who believe that control of emissions from road vehicles is merely a matter of simple treatment of the fuel, slight modification of engine design or simple additions to the exhaust system.

Diffusion flames are analytically treated, taking into account the basic principles followed by examination of vapourisation, dispersion and the energetics involved. Air and fuel interaction in sprays is examined in detail.

Whilst it is clear that the Author's main experience has been concerned with combustion of liquid fuels, particularly in regard to internal combustion engines, he has not overlooked the importance of his work in the field of solid fuel combustion. He deals with the fundamental principles of overfeed and underfeed methods and discusses the mechanics of fluidised beds. The latter is most topical in view of the interest now being taken in the up-dating of the process. As the future will undoubtedly see an upsurge of solid fuel burning plant in the U.K., both alongside North Sea Oil and after these reserves are worked out it is considered that this reference to solid fuel in this context is most useful.

The final chapter of the work is concerned with practical applications in both static and moving sources. In view of the interest in the possibility of toxic emissions from municipal incinerators, the references to the difficulties of handling a mixed fuel and the special problems concerning the incineration of difficult metals and organic compounds are timely.

Appendices are included to denote methods of expressing concentrations of trace species which are complicated in nature and extremely small in quantity, along with explanations of the terminology used in this ' micro ' science.

From solid fuel combustion and the particulates involved through to the irritant effects of ozone and PAN (peroxyl acetyl nitrate) is an extremely wide front for any author to attack, particularly in a book of 225 pages, and the technique employed is in itself of interest. Over 80 illustrations, figures, monographs and tables are used in the text and are presented with the utmost clarity. Being conscious of the limitations he has set himself, the Author has, however, provided over 250 references to allow the reader to delve more deeply into the subject of his choice.

To compose a short summary of a book of such wide scope is impossible but it is clear that those who look on a smoke-free chimney stack with satisfaction are deluding themselves. The invisible is always more suspect than the visible. A study of this book amply demonstrates the vast amount of work, both academic and practical, which needs to be done to produce acceptable combustion conditions within a total environment.

This book's comprehensive nature demands for it a place, not in the library, but in the top right drawer of the desk of the engineer, the chemist, the administrator and all those whose interest lies in the provisions of Clean Air rather than Clear Air.

H. Brown

Everyday Meteorology
by Austin Miller and M. Parry. Hutchinson Educational —272 pages, £4·95 net.

This is a second revised edition of a book first published in May 1958 and which was very well received. The first edition, by skilful use of diagrams and prose of exceptional clarity, explained the structure and functions of the atmosphere extremely well. This new edition explains in greater detail than is usual in such works, the behaviour of the weather and its everyday importance to the quality of life of the community.

Everyone who is concerned with clean air and the control of air pollution must be interested in the weather and should have at least a nodding acquaintance with meteorology. This book is written for the layman and for the student. It includes chapters on the raw material of weather studies, the processing of weather information and the causes of weather. It then goes on to discuss air mass properties, air mass types, fronts and frontal disturbances and atmospheric circulation.

Although the book is mainly concerned with British weather, there is a chapter on the world weather types; but perhaps more important there is a very interesting discussion of local influences and local weather.

Air pollution is dealt with in a chapter on its own headed ' The abuse of the atmosphere ' and it is interesting to see that here mention is made of the Society and the "Clean Air Year Book". The problems of weather forecasting are then discussed and the final chapter in the book talks about living with the weather. ' Living with the weather is rather like living with a moody relative whose presence in the house, though unavoidable is not of our own choosing. In both cases we live with the intruder more successfully the better we understand it and understanding leads at least to toleration and some degree of adjustment.'

In recent years certain notions about the weather have become outmoded while others have become more fashionable; remote sensing has added a new dimension to weather observation, and the computer has revolutionised forecasting. What has not changed so significantly is perhaps the weather itself, the weather awareness of the man in the street and his interest in the weather so far as it affects his work or his outdoor recreation. As the preface to the book points out ' not one of us in fact, can opt out of our status as "consumer" vis-a-vis the weather and indeed from some points of view, our susceptibility seems to be greater now than ever it was.' Although a text book in form, ' Everyday Meteorology ' is written in such an interesting manner that one cannot help reading on. The book possesses an adequate index and is well produced. Apart from its readability, it is an excellent reference book.

Atmospheric Diffusion
by F. Pasquill, 2nd edition, publ. Ellis Horwood, Chichester (and John Wiley, New York), pp 429, £16.

Some authors write a personal monograph, others aim at a comprehensive work of reference. Most make some sort of compromise, but Dr. Pasquill has managed to achieve the best of both. This is a uniquely authoritative book which will surely remain unchallenged for a long time. The subject is a difficult one, not neatly cut and dried, and therefore unsuitable for undergraduate study: it is far too perplexing.

The greatest problem in atmospheric diffusion is its complexity. In this respect it is a branch of physical science, ahead of all others. It is a mixture of the most sophisticated concepts of fluid mechanics and measurements from the most extensively observed medium and it has achieved a maturity which puts it in the evolutionary lead. More observation and more theory are unlikely to increase our prowess at predicting (in spite of the pretentions of some wind tunnel operators) but will merely emphasise that present purposes are scarcely worth pursuing further. Since there is an awful possibility that the managers of society will require a pollution monitoring system for the air in order to optimise something or other, I would make Pasquill's book required reading for anyone presuming to impose objectives on others in this field, and demand an essay on the theory of designing the information flow appropriate to air pollution administration. Most people seem to assume that no such theory is necessary: I think that the attempt to formulate it would show that we should not set our objectives in advance.

We are at the point now when effective advances can only be made by introducing new objectives and purposes and abandoning some of the old ones as unattainable or not worth attaining. This has been a good moment for the author to state what has been achieved, and how; for the statement will endure for a long time.

In this second edition there is a separate short introductory chapter which will guide the reader's expectations. He ends with an expanded discussion of how to predict dispersion in practice. In between much has been completely rewritten, although large sections on the basic theory and observational techniques remain, but with additions. One hopes that readers will not be tempted to extract what appear to be instructions for the practitioner as if the rest can be ignored as further development above the practitioners level. The chief value of the book, apart from the obvious hard work in setting it all down so that no important idea or observation is missed, lies in the explanations he gives of what theories really imply. Pasquill is not content simply to ensure that it is all there somewhere for the reader and it's up to him to extract what he wants: he looks from new angles at the way theories are contrived and what observations imply, and often gives the illusion that it is much simpler in principle than it really is. The theory may well be simple, but reality isn't, and the theory is only another device for looking at reality.

Unlike normal engineering where the purposes are defined so as not to make impossible demands on theory and knowledge, the purpose in atmospheric diffusion is defined by what is there, not by what we choose to design or aim to achieve. New work in the subject is bound to increase our knowledge of its complexity, and cannot be expected to produce grand simplifications. One hopes that workers in this field have learned this lesson, which economists and sociologists obviously have not learned, and that they will not, like the medical profession, seek to add always one more "technological fix" to cope with difficulties created by the previous ones. There is a degree of complexity in the practice of a science or technology beyond which the practice takes over command of the person and we are compelled to go on simply because the problems seem to be there in profusion and we haven't had time to look around at where we are heading. The medical profession is faintly perceiving at last its dreadful responsibility for the population explosion, and the provision of health services is becoming a bottomless chasm into which increasing resources will be poured with diminishing effectiveness. We must learn the lesson quickly before pollution management is taken over by a highly computerised bureaucracy which no individual, corporation, government, or army can resist or control.

One, probably unintended, message of the book is that life is far too short for it to be worthwhile trying to attain our full technological potential. We have to be content with other objectives, because technology can be a very inefficient means to support the body and the intellect because of the multifarious secondary exercises it requires additional to the main purpose. It is often easier and quicker to let something happen than to try to predict how it would if you did. Atmospheric diffusion illustrates well how absurd purposes are frustrated; by good fortune we have learned this with less pain than in many other more expensive fields of endeavour.

Professor R. S. Scorer

Air Pollution

by D. J. Spedding. Oxford Chemistry Series No. 20. Clarendon Press Oxford 1974. pp 76. Price £1·20.

The Introduction to this academic little book concludes with "It is my hope that at least some of the readers of this book will be sufficiently stimulated by the breadth of research that remains to be done, that they will orient their work to the field of air pollution".

Many of the readers of the British Corrosion Journal, who take a very practical interest in this matter may think it extraordinary that the author and the three editors are not listed as subscribers to the national bodies that have had great success in the past doing practical things to minimise air pollution. This little book makes no reference to "The Clean Air Year Book for 1974", in the 120, A4 size, pages of which Air Pollution Research Programmes in the United Kingdom are listed on pages 45-61: a massive aid to any practical research worker on air pollution. The author of this little book does not list in his references Dr. A. R. Meetham's classic book on Atmospheric Pollution its Origins and Prevention, in its 3rd edition with 301 pages (Pergamon 1964) or Alan Gilpin's Control of Air Pollution that started with a Foreword by Sir Hugh Beaver and ended with a splendid 19-page index. (Butterworths 1963).

In 1972 the D.T.I. and U.K.A.E.A. jointly estimated that air pollution costs Britain about 2% of its gross national product. Making nationwide use of some twelve hundred British Standard Institution specified instruments in our National Survey of Air Pollution for the past dozen or more years, Warren Spring Laboratory has published its findings in massive H.M.S.O. volumes. Surely that deserved mention in this little book.

This reviewer finds it inexplicable that a British book on Air Pollution should omit to refer to the internationally pioneering work of the National Society for Clean Air, and its predecessors from 1899 to date, that produced the beneficial British Clean Air Acts of 1956 and 1968. The British Standards Institution pioneered in producing the specifications for the first instruments to be nationally standardised in any country for measuring air pollution, and that was before the most fatal London ' smog ' of 1952. For the past 30 or 40 years representatives of upwards of 400 Local Government Authorities have met half yearly to discuss air pollution matters in the Standing Conference of Co-operating Bodies in the Investigation of Air Pollution. Last year the Technical Committee of the National Society for Clean Air initiated the production of a glossary of terms used in the study of air pollution, and this will help those who now have in hand the production of an international glossary.

This is important because since its inception in 1965 the International Union of Air Pollution Prevention Associations has now grown to twelve full corporate members and six affiliate members.

The author of this little book deals with the chemical composition of the atmosphere, the nature and behaviour of aerosols, CO$_2$, Ozone, SO$_2$, Nitrogen Oxides, CO, minor pollutant gases, and indoor pollution. But his index does not even list air-ionization, yet city dwellers breathe ion-depleted air. Many people dislike the dry air of central heated rooms. Is that because of the lack of humidity, air motion, or the degree of ionization? Electricity in the air may be crucial to health.

Moreover he does not even mention NOISE which should be listed as one of the most injurious of the air pollutions. even if it is not analysed by chemical apparatus.

It is fair to add that those who have had the experience of taking samples of air pollution in a gale of wind, torrential rain, or ice and snow will be very cautious in accepting all the figures quoted.

For example Table 2.4 page 15 lists concentration of some elements and salts from districts of different geography (Windermere, Stockton, and Pasadena) but does not say how the samples were taken or why Windermere is (μgkg^{-1}) and the other two places (μgm^{-3}). Unless internationally similar instruments, siting, and units are used such lists of figures may mislead. If the two British figures were obtained with B.S.I. specified instruments the units should be the same.

T. Henry Turner

“Clearing the Air—Federal Policy on Automotive Emissions Control”

by H. D. Jacoby and J. D. Steinbruner and others. John Wiley & Sons Ltd. 213 pages. £7·20.

The first paragraph of this book reads “In the 1970 amendments to the Clean Air Act, the United States has embarked on a major adventure in Government regulation. The amendments mandate drastic reductions in the air pollutants emitted by automobiles and require that these reductions be achieved by the 1975 and 1976 model years. These regulations strike at one of American society’s fundamental technologies and impose strict discipline on its largest industry. More than 10% of the United States gross national product is generated by the production, fuelling, and servicing of the internal combustion engine in its automotive application; the associated social and political forces are commensurately large. The enactment of this legislation over the opposition of the automobile industry was an impressive display of public resolve, and the fact that the industry is now actively working to comply is a major victory for the public interest.” This paragraph sets the tone of this very comprehensive book which examines the present United States’ legislation and its effects. The study was undertaken as a joint effort by two research projects at Harvard University.

Nevertheless, in spite of investigations in great depth, the authors arrive at no real conclusions. While admitting that the rather bureaucratic regulations imposed are complex, difficult to achieve and very expensive in research costs and eventual increased fuel consumption, the authors do not seem in a position to make any definite statement about how much cleaner the air will be as a result. Generally, the book goes far beyond discussion of the immediate critical issue because it tends to regard this issue as representative of a broad class of problems which are raising themselves within modern society. It is perhaps because of this that the book tends to lose its way and become involved with political and sociological factors—although regard is given to technical and economic considerations.

The book is readable though perhaps rather prolix; it is well referenced and there is a reasonable index. After reading it one is left with the conclusion that perhaps in some ways we do things better in this country!

“The Chemistry of P.C.Bs”

by O. Hutzinger, S. Safe & V. Zitko. C R C Press Ohio. 269pp. £18·69 approx.

This book describes in good detail the chemistry of the polychlorinated biphenyls (P.C.Bs), the literature is covered up to 1973 and countless references are cited.

P.C.Bs are manufactured by the chlorination of biphenyl in the presence of iron filings or ferric chloride as catalyst. The products are complicated mixtures. Each isomer is a solid but the isomers effect mutual depression of melting point resulting in liquid mixtures. Various grades of P.C.Bs are sold with chlorine atoms per molecule of approximately 1·5, 3·6, 5·6 and 7·7 respectively in the four common grades. These compounds are relatively inert to heat, oxidation, acids, bases, and other chemical reagents and they have excellent dielectric properties. They are used in electrical capacitors and transformers, vacuum pumps and have also been used in hydraulic fluids, adhesives, plasticisers, heat transfer systems, pesticide extenders. Although some chlorobiphenyls were shown to have insecticidal and fungistatic activity, they were apparently never used as pesticides though recommended.

In view of the persistence of other chloro compounds in the food chains, it is hardly surprising to learn that P.C.Bs were eventually detected in the environment (in 1966) so interest in them grew rapidly. The solubility of P.C.Bs in water is extremely low and decreases with increasing chlorine content, the lipid solubility is high They are strongly adsorbed onto various surfaces—wood, plastic, glass and onto silt.

Two hundred and nine different chlorobiphenyls do theoretically exist but it is unlikely that all can be formed in their preparation, for example, a compound with several chlorines in one ring and none in the other is an improbable product. It will be appreciated that the complexity of the mixtures leads to difficulties in their analysis in environmental chemistry especially when their concentrations are determined in the presence of other chlorine containing compounds.

The book deals with every aspect of the chemistry of P.C.Bs and their effects. As well as describing what is known about them it also mentions what has not been investigated, for example, although information on the acute and chronic toxicity of P.C.Bs to a variety of animals has been obtained by the study of commercial mixtures, little is known about the toxicity of individual compounds. ‘The mechanism of the toxic action of P.C.Bs is not known’.

The introduction gives a brief review of the toxicology and the organisms studied, and the nomenclature of P.C.Bs.

The commercial preparations and their physical data are tabulated. Solubilities, vaporisation rates, GLC retention times are listed. Compositions of commercial mixtures are given.

The synthesis of chlorobiphenyls and isotopically labelled compounds follows together with tables of these compounds, melting points, references to the synthesis route and the literature reference.

The next chapter deals with new syntheses of biphenyls which have not yet been applied to P.C.Bs. This chapter also includes the chlorobiphenylols which are found as metabolites of P.C.Bs in some organisms.

Chapter 5 deals with chemical reactions of P.C.Bs. Since P.C.Bs are noted for their stability and unreactive nature, this is a short chapter.

Photochemical degradation has been shown to be a possible major route for the breakdown of P.C.Bs, this is recent work (1971 ff) where mass spectrometry is used to analyse products.

Metabolism is dealt with in chapter 7 and includes work on micro-organisms.

The next four chapters deal with mass spectrometry, nuclear magnetic resonance spectroscopy, ultra-violet spectroscopy, infra-red spectroscopy.

Chapter 12 deals in great detail with the determination of P.C.Bs involving sampling, precautions against contamination, extraction, cleanup, chromatography, confirmation of P.C.Bs, determination.

The last chapter is on recent developments.

Many pages are taken up with the extensive tables and spectra. The references for each chapter are collected at the end of the chapter and nine hundred and seventy references are quoted—some will of course be replicated from one chapter to another. The book is well produced, gives a lucid and concise account of the chemistry of P.C.Bs and should be invaluable to every worker in this field and to any scientist commencing work in this field.

N. Entwistle

Prevention of Air Pollution in the Non-Ferrous Metals Industries

E. C. Mantle, M.Sc., F.I.M. August 1974. Prepared by BNF Metals Technology Centre at the request of The International Wrought Copper Council.

The information contained in this manual will be of considerable value to all working in the field of air pollution control. It covers many aspects of the subject ranging from legislation to methods of monitoring emissions.

In discussing the various metal refining processes suggestions are made for the control of particulate emissions. A useful table of emissions in the non-ferrous metals industry and what can be achieved by control is given.

Methods for cleaning scrap before smelting to minimise smoke emissions are considered and attention is drawn to possible hazards to operators where solvents are used. The difficulty of stripping PVC covered copper wire is noted. An important aspect of pollution in the industry is the maintenance of a satisfactory factory atmosphere and ways to contain fume are adequately discussed. Mention is made of the dispersion of such fumes into the ambient atmosphere; but unfortunately little information on their abatement at the source of emission is given.

A good discussion on the dispersion mathematics and meteorological considerations is included although rather surprisingly particulate deposition rates are omitted. There is a tendency to overstate the merits of dispersion with regard to global emissions; but for local effects, their views are correct.

The manual is set out in a clear and logical manner and is comparatively free from typographical errors. A section on sampling however does not make it clear that the square root of absolute temperature is required to calculate gas velocity V. (Page 173).

The author and industry are to be commended for producing a very informative manual.

S. C. Wallin

New additions to the National Society for Clean Air Library, available on Loan

Atmospheric Diffusion—2nd Edit. F. Pasquill. Ellis Horwood Ltd.

New Agricultural Landscapes. October 74 (paper). Countryside Commission.

Prevention of Air Pollution in the Non-Ferrous Metals Industries. Manual prepared by BNF Metals Technology Centre. E. C. Mantle.

The Effluence of Affluence. Edited by F. Taylor, P. Kettle, R. Putnam. Methuen.

Analytical Methods Applied to Air Pollution Measurements. Robert K. Stevens, Research Chemist, and William F. Herget, Research Physicist. Ann Arbor Science.

Everyday Meteorology. A. Austin Miller and M. Parry. Hutchinson Educational. Revised Edit.

Air Pollution. D. J. Spedding. Oxford Chemistry Series No. 20. Clarendon Press, Oxford 1974.

FUME INCINERATION

by

M. D. Ward

This paper was presented to a meeting of the Yorkshire Division, held at the works of John Thurley Ltd. at Harrogate on 5th March 1975.

Introduction

Many industrial processes produce "fumes" as an unwanted by-product. These "fumes" vary considerably in composition and some of them can be eliminated by the process of high temperature oxidation, commonly called Incineration. Toxic odours or visible fumes caused by combustible contaminants can be destroyed by incineration. Fumes suitable for incineration usually consist of an air stream containing various combustion products (carbon dioxide, water vapour, carbon monoxide, etc.,) and varying amounts of organic vapours.

They occur mainly in the following industries:

a Food processing plants—for example as fumes extracted from fish fryers, offal boilers, fish meal dryers, corn product dryers, coffee roasters, fat rendering plant, and meat smokehouses.

b Manufacturing industries—commonly oven exhausts from solvent based point dryers, plastic coating dryers, fibreglass curing ovens, lithographing ovens, textile dryers, and wire enamelling ovens. Fumes are also produced from various other items of process equipment such as solvent degreasing plants, scrap lead melting furnaces, and oil quenching processes. Batch type chemical reactors also often produce combustible gaseous by-products which are vented to atmosphere.

Applications of Fume Incineration

In order to decide whether incineraton is the best method of pollution control it is necessary to have the following information available on a specific "fume":

1 Temperature
2 Volume
3 Chemical composition
4 Dew point
5 Permissible atmospheric tolerance levels for the pollutants present in the fume.

Temperature and volume data are needed in order to calculate the necessary heat release required and hence size the incinerator.

Chemical composition is used to ensure that the fume contaminants are compounds which will rapidly oxidise at high temperatures giving harmless products. Sometimes the incineration process produces toxic gases which may require further treatment prior to being discharged to atmosphere. It is also necessary to ensure that enough oxygen is present to ensure complete combustion. If the fume has an oxygen deficiency then secondary air must be added.

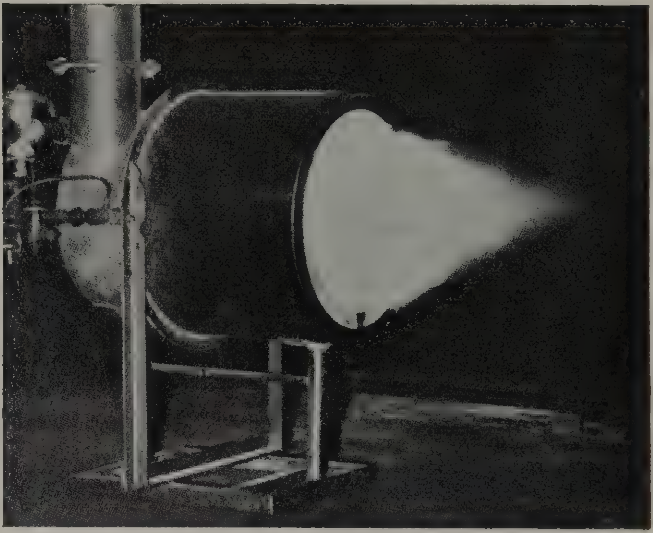


Fig 1 *Vortex burner firing*

Knowledge of the dew point is required in order to ensure that temperatures throughout the system are maintained above the level at which condensation could occur.

Permissible tolerance levels of incineration discharges should be specified by the customer so that the correct incinerator can be selected. Acceptable pollution levels vary widely from country to country and also depend on the local environment.

Having examined the above information and decided that incineration is the best disposal method, we must decide which is the best method for incineration. There are three basic types of fume incinerator:

1 Direct Flame incineration or Burner incineration
2 Thermal oxidation
3 Catalytic oxidation.

1 Direct Flame incineration (or Burner incineration)

This method is used when the "fume" is a waste gas which is at or near its lower combustible limit when mixed with air. It can also be used when the waste gas is a combustible mixture without the addition of air.

In a well designed, high intensity combustion unit such as the Vortex burner (see Fig. 1), gases having heating values as low as 100 Btu/ft^3 can be burned without auxiliary fuel. Even lower heating value material can sometimes be burned without auxiliary fuel if they and the combustion air are preheated to permit the necessary combustion reaction temperature to be reached.

(This preheat temperature may be 600 or 700°F.)

Typical examples of waste gases which can be burned directly in a suitably designed burner are:

Carbon monoxide, hydrogen cyanide, hydrogen sulphide, solvent vapours, chlorinated hydrocarbons, and various other combinations of combustible gases.

When the amount of combustible material in the fume is below the lower flammable limit it is possible to add natural gas or other types of auxiliary fuel to sustain combustion in the burner. In this type of application the fume is serving as part of the burner fuel and is contributing a significant part of the total heat release of the system. Burner incineration, to be economically feasible, should only be used when the amount of auxiliary fuel needed to sustain combustion is low and where the contaminant supplies approximately 50% or more of the heating value of the mixture. Burner combustion occurs at temperatures above 2500°F. and the resultant products of combustion are water vapour, nitrogen and carbon dioxide. Some of the waste gases mentioned previously namely, hydrogen sulphide and chlorinated hydrocarbons, produce toxic combustion products in the form of sulphur dioxide, sulphur trioxide or hydrogen chloride. These types of effluent gases must be further treated by processes such as liquid scrubbing before being passed to atmosphere.

2 Thermal Oxidation

The largest number of fume incineration problems involve mixtures consisting of an airstream contaminated with very small amounts of combustible organic material. This type of fume, if injected directly through a burner, would require large quantities of auxiliary fuel to achieve combustion. Most industrial burners require temperatures of upwards of 2200°F. to sustain combustion, whereas thermal oxidation can be completed at much lower temperatures. Thermal oxidation can be completed at temperatures as low as 900°F., but generally temperatures between 1000°F. and 1500°F. are required. Typical heating values for these types of fumes are very low, between 1 and 20 Btu/ft^3.

The design of the incinerator is based around the so-called three T's of good thermal oxidation:

Temperature, Time and Turbulence.

a Temperature

The temperature must be high enough to ensure oxidation of the combustible contaminants to the required level.

b Time

Time is the period of residence of the waste gas in the incineration chamber. This will vary depending upon the temperature and the turbulence but should be between one-quarter and one second for most fumes.

c Turbulence

Turbulence is the degree of mixing between fumes and burner combustion products. It is readily apparent that if the temperature is high, then less turbulence and less residence time will suffice. Similarly if the temperature is low, longer residence time and better turbulence is required. If the turbulence is very good, then a reduction of temperature and residence time may be achieved.

Since turbulence or mixing is the easiest and cheapest of the three factors, it should always be treated as the most important. Long residence times make the incinerator larger and more expensive, and higher temperature utilises more auxiliary fuel, resulting in higher running costs.

Methods for attaining adequate mixing and adequate temperature distribution

1 Combustion Chamber Geometry

The fumes pass the burner outlet and are then turned once or twice through 90° or 180° in order to create turbulence:

2 Refractory Restrictor

After passing the burner outlet, the mixture of combustion products and exhaust gas is forced through a restrictor into a residence chamber where eddies created by the orifice induce the required mixing:

3 "Disc & Doughnut" baffles

The mixture of fumes and combustion products passes through a series of baffles which create large recirculation zones by expansion and contraction of the gaseous stream:

4 Vortex Flow

A high velocity burner fires tangentially into a cylindrical chamber while fumes are introduced axially through the end of the chamber. The high velocity jet of combustion products creates a vortex in the chamber with a powerful swirling action and reverse flow along the centre line of the incinerator. The fumes are entrained in this swirling mass of hot gases and rapidly brought up to the incineration temperature:

5 Special burner design

Heating a typical fume stream to a temperature of 1400°F. with neat gas fuel is roughly equivalent to burning fuel gas with 300% excess air. Burners have been developed for doing this job and they use, for combustion, oxygen taken from the fume stream itself. Such a burner is the Maxon 'Combustifume' burner (see Fig. 2), which is really a very sophisticated deveolpment of the simple bar burner.

It consists of a fuel gas manifold of roughly tubular form fitted with high temperature metal mixing plates. The burner is placed in the fume stream with the manifold section perpendicular to the direction of flow and

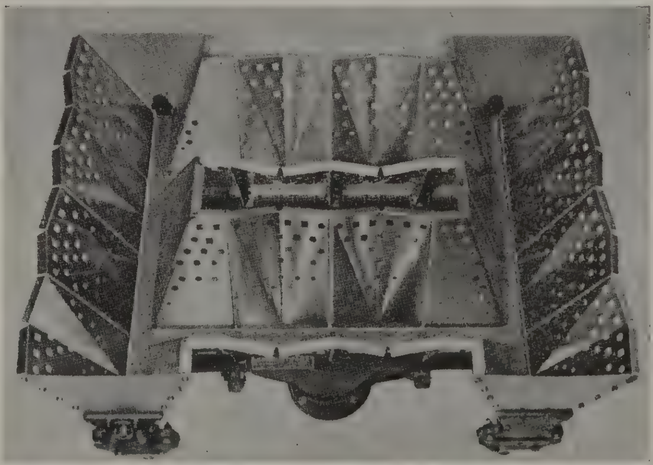


Fig 2 *8 linear ft of Maxon 'Combustifume' burner* the open ends of the ' V ' section mixing plates downstream. The flame stabilises inside the mixing plates, as the fuel issues from the manifold and the fumes are forced through the holes in the plates. If the fumes contain 16% or more of oxygen by volume, as is more often than not the case, then only neat gas need be fed to the burner. If the fumes contain between 11 and 16% oxygen, then a small quantity of air can be mixed with the fuel gas as a "partial premix" to help stabilise the burner flame.

Fumes with oxygen contents below 11% cannot be handled in the ' Combustifume ' burner and recourse must be made to the more conventional incinerator. The burner is closely profiled so that all of the fumes pass through and over the mixing plates and this results in extremely rapid mixing of all the fume with the combustion products and immediate ignition of contaminants.

This mixing process is so thorough that any given percentage conversion of the contaminants in a ' Combustifume ' incinerator can be achieved at lower temperatures and with lower residence times than conventional incinerators fired with a single tunnel-type burner for example.

The Combustifume burner is built up on the modular concept so that burner assemblies can be built up to match specific fume flow rates. The heat release of a Combustifume assembly can be virtually infinite, the only constraint being the physical size of the burner. Another advantage of this type of incinerator is that the highest temperatures occur at the burner, which is in the centre of the duct. Hence the walls of the duct are never subjected to flame impingement and only ever reach incineration temperature. This enables cheaper, lower duty refractory to be used.

Design and Operating Information on Combustifumes and Comparison with other types of Incinerator

Incineration temperatures used in Combustifume incinerators depend on the application. Generally they are:

a	To control odours	900-1350°F.
b	To oxidise hydrocarbons	900-1200°F.
c	To oxide carbon monoxide	1200-1350°F.

The incinerator is normally designed to be able to reach 1500°F. and actual operating temperature is determined by experiment to obtain the required degree of contaminant conversion.

Fig. 3—Efficiency graph—shows an interesting comparison on some aspects of direct thermal oxidation. A fume incinerator was built with a tunnel burner, firing axially along the unit (see Fig. 4). The combustion

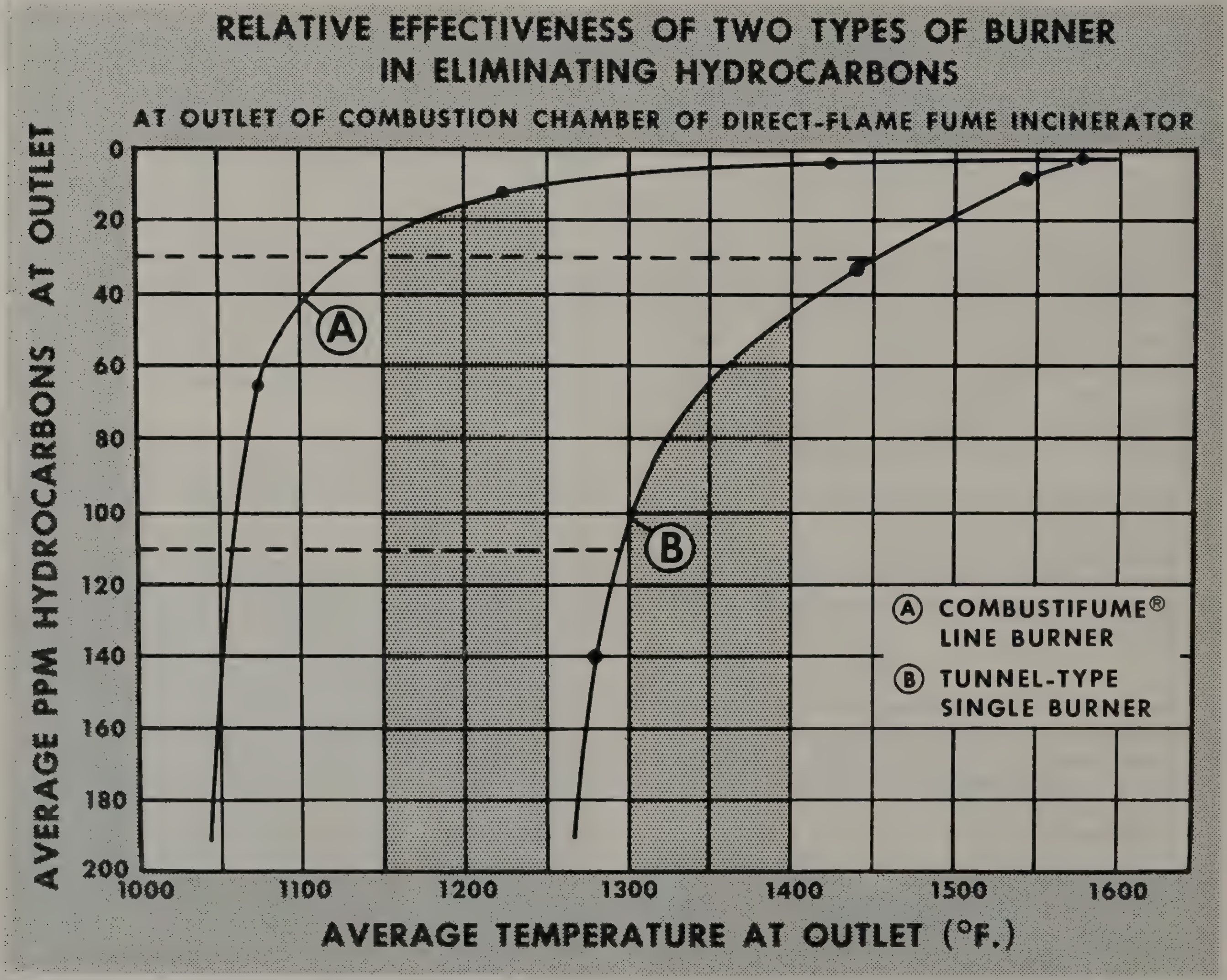


Fig. 3 *Temperature/efficiency graph*

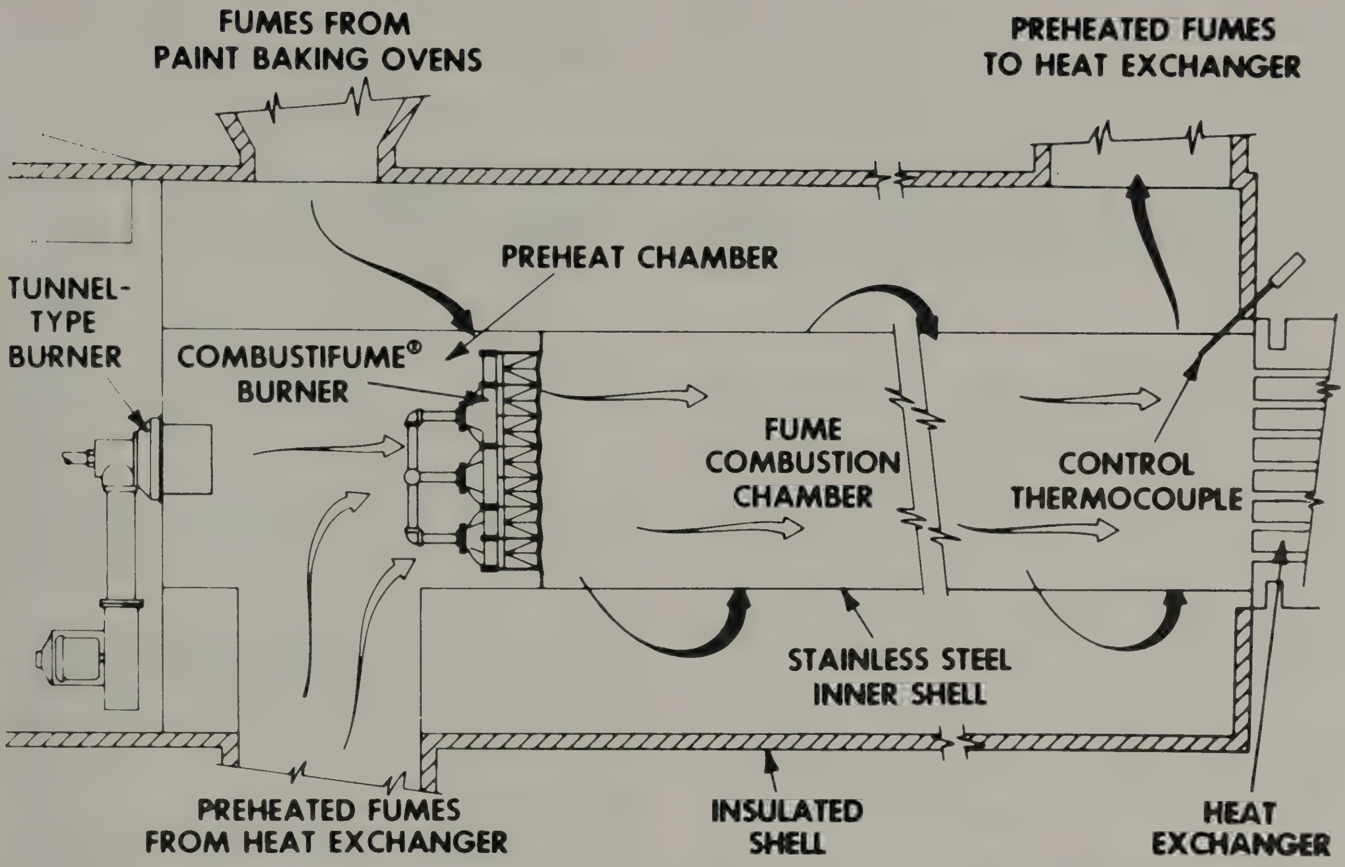


Fig. 4 *Fume incinerator using tunnel burner initially, then replaced by 'Combustifume' burner*

chamber geometry (i.e. 90° fume turn as the fumes are passed across the burner) was used to facilitate mixing. Performance data was obtained with this configuration, and the tunnel burner was subsequently replaced by a Combustifume burner mounted downstream of it. Performance figures were again obtained and the results of the two configurations are shown on the graph, which plots hydrocarbon concentration in the exhaust gas after incineration against incineration temperature. Two of the items of interest are the dependence of fume removal efficiency on temperature and the actual level of efficiency which can be obtained. These results are typical for a direct Thermal oxidation process. As can be seen, initial percentage conversion increases rapidly with only small rises in incineration temperature, whereas reduction of hydrocarbons to a very low level requires much greater increases in incineration temperature.

Perhaps the most striking thing about the curves is the dramatic decrease in temperature required to achieve a given "clean-up" when the tunnel burner is replaced with the Combustifume—and this is despite a decrease in apparent residence time resulting from the necessity to place the Combustifume burner downstream of the tunnel burner. As can be seen, the Combustifume temperature for a 20ppm hydrocarbon level at the incinerator outlet is 1175°F., whereas a temperature of almost 1500°F. is required from the tunnel burner. The reduction in fuel costs achieved by use of a Combustifume incinerator is clear.

The explanation of this phenomenon lies in the efficiency with which all of the fume is brought to the incineration temperature (i.e. turbulence, the importance of which has already been emphasised). In the system using the tunnel burner, the fume stream and the hot burner gases move down the incinerator along parallel paths, the burner products forming a hot core which diffuses comparatively slowly into the cooler fumes. In the Combustifume system the fumes are all forced through the burner mixing plates into contact with the flame and have achieved virtually complete mixing as they leave the burner.

Thus to conclude the subject of thermal oxidation let us briefly examine what system would be used for a specific fume problem:

a The Combustifume—is the most efficient burner in terms of auxiliary fuel usage and enables smaller incinerators to be used, but it has the following limitations:

i The burner is designed for a given fume flowrate. It is only possible to vary fume flowrates over a limited range as burner flame stability is dependent on maintaining a specific fume pressure drop across the burner.

ii Cannot be used for fumes with less than 11% by volume of oxygen.

iii Cannot be used if dust or solids are present which are likely to block up the holes in the burner mixing plates.

iv Can only be used for clean, gaseous auxiliary fuels such as natural gas or propane.

v Cannot be used if fumes contain compounds which will attack the materials from which the burner is made.

b Tunnel type burners in various different orientations

Generally, tunnel burners are used when any of the points already stated rule out the use of a Combustifume. The type of burner orientation used (i.e. combustion chamber geometry, refractory restrictor, Disc and Doughnut baffles, Vortex flow) depends on the type of auxiliary fuel available and the type of fumes to be handled—the correct system being chosen mainly from previous practical experience but here again turbulence is the primary consideration.

3 Catalytic Oxidation

Catalytic oxidation is usually considered for gaseous wastes containing low concentrations of organic contaminants where the temperature rise across the catalyst will be of the order of a few hundred degrees F. A catalyst is defined as a substance that can increase the rate of a chemical reaction, under given conditions of temperature and pressure, without its own composition or chemical nature being changed in the process. In oxidation reactions, necessary for fume destruction, the use of a catalyst can greatly lower the temperature required for the incineration of contaminants.

Most catalysts are suitable for maximum operating temperatures of about 1500°F., so it is important to check that the heating value and concentration of organic contaminant will not cause too high a temperature rise across the catalyst with consequent catalyst burnout.

The applications for catalytic oxidation are similar and competitive to thermal oxidation but catalytic oxidation offers savings in auxiliary fuel. This is particularly the case for small size units treating fumes with a low concentration of contaminants where economics or plant requirements do not justify the installation of heat recovery equipment.

The catalyst, itself, is usually a precious metal, such as platinum or palladium, dispersed on some form of catalyst support or carrier. The carrier should be capable of withstanding the maximum catalyst operating temperature. It should also have a shape which gives a high geometric surface area and a configuration which gives a low pressure drop. A typical carrier is alumina, formed in granules or honeycomb structures with the catalyst dispersed on the surface. Generally honeycomb types of catalyst give lower pressure drops and are used if any particulates are present in the fume. However, granular types are generally the most efficient.

Preheat burners are required to raise the temperature of the fume to the level which is required for the oxidation reaction to proceed on the catalyst surface. Preheat temperatures of between 600 and 1000°F. are normally required. This obviously offers considerable savings in auxiliary fuel usage when compared with the temperatures of 1500°F., or thereabouts, required for straight thermal oxidation.

The catalysts we use generally have an operating life of approximately 20,000 hrs, are guaranteed for 8,000 hrs operation and are non-regenerable: in other words, they must be replaced with new catalysts when they are exhausted.

The factors involved in the economic evaluation of the use of catalytic oxidation as opposed to straight thermal oxidation can be summarised as follows:

1 Auxiliary fuel savings due to reduced operating temperatures.

2 Higher initial capital cost with catalytic systems.

3 Catalyst life expectancy and replacement cost. Catalyst life can be substantially reduced by:

  a Poisoning—Compounds such as phosphorous, silicon, lead, arsenic, iron, vanadium, halogens and sulphur, which may be present in a fume stream all adversely affect catalyst efficiency and life to a greater or lesser extent. It is thus important to accurately determine fume compositions before proceeding with a catalytic system.

  b Dust—Effective catalyst surface area can be appreciably reduced by dust deposits: e.g., food particles or pigments from paint baking ovens can reduce catalyst life.

4 Comparison between thermal oxidation with heat recovery and catalytic oxidation with regard to the best return on capital investment. Generally a catalytic system will appear more attractive on the smaller scale units.

Heat Recovery

Because fume incinerators operate at relatively high temperatures they are ideal for the incorporation of heat recovery. The waste gas flow rate should be more than about 2000 ft^3/min., which is equivalent to an incinerator heat output of about 3 to 4 $\times$ 10^6 Btu/hr to make heat recovery an economic proposition at today's fuel prices.

Heat can be recovered by using the hot gases from the incinerator to preheat fresh air for the oven whose exhaust fumes are being treated, or for other applications. Similarly, they may be used to raise steam, to provide high pressure hot water, or to heat up heat transfer oils, which are gaining in popularity as a heating medium. It is even possible to recirculate a portion of the hot incinerated gases directly back to the process equipment. However, with all these methods there is a limit to how much heat can actually be made use of in the process plant or elsewhere. Consequently it is much better to use a heat exchanger to transfer as much heat as possible from the hot gases, leaving the incinerator to the fumes entering the incinerator, and then to use a second heat exchanger, or direct recirculation of the incinerated gases, to provide heat for the process. A system installed with one heat exchanger can economically recover as much as 70% of the heat content of the incinerated gases. Systems using two heat exchangers are in operation economically recovering up to 80% of the waste heat.

It is, however, perhaps worth noting that heat exchangers of the type necessary for high temperature operation require careful design and selection of fabrication materials. As a very rough rule of thumb the addition of a heat exchanger to a given incinerator installation is likely to increase the overall system cost by a factor of 2 or more. However, with the soaring costs of fuel the additional cost of a heat exchanger can often be recouped in periods of under two years operation when one takes account of the significant reduction in fuel requirements.

National Society For Clean Air

NEWS FROM THE DIVISIONS

EAST MIDLANDS

Report of a meeting held at Derby on 27th March 1975.
Members assembled at the Council House where after coffee served by kind invitation of the Mayor, the morning part of the proceedings took place in the Council Chamber.

A Civic Welcome was extended by His Worship the Mayor of Derby (Councillor George Salt, J.P.). Referring to the programme which centred round Rolls-Royce (1971) Limited, the Mayor said that people naturally associated this famous name with Derby but there were many other industrial undertakings in the town covering widely differing aspects of manufacture. Councillor Salt outlined the progress made in Derby towards clean air which included notable improvements in industrial emissions and the inclusion to date of some two-thirds of the dwellings in smoke control areas.

The Chairman of the Division Dr. R. V. Riley, Ph.D., suitably thanked the Mayor for his welcome. Dr. Riley also expressed the thanks of the Division to the Mayor and the Derby Borough Council for the facilities offered for the meeting, for the hospitality and for the use of the Reception Room for the lunch.

Apologies were received from Mr. J. B. Brackenbury, Mr. K. R. Enderby, Mr. G. Fox, Mr. R. W. Lander, Mr. A. Lister Robinson, MBE, Councillor J. E. Hall, Councillor W. R. Cashmore, Councillor R. Chamberlain, Mr. B. T. Jones, Mr. H. S. Whitten and the representatives from Newark District Council.

Following notices by the Secretary and confirmation of the report of the meeting at Ratcliffe-on-Soar on 31st October 1974 the Chairman introduced the Secretary General of the Society Rear Admiral P. G. Sharp, CB, DSC.

Rear Admiral Sharp said that he had spoken twice to the Division in fairly recent times about the changes brought about by Local Government Re-organisation. The changes had now taken place both in local government and the Society and we were getting used to them. There were still problems and misunderstandings with local authorities about membership, but efforts would continue to bring all authorities into the Society.

The broader horizons and terms of reference were reflected in the enquiries being received at Headquarters, and in the programmes both of recent seminars and the forthcoming International Conference at Brighton. The Year Book—now the NSCA Year Book—contained sections on all aspects of pollution and on conservation.

New legislation, especially the Health and Safety at Work Act 1974 and the Control of Pollution Act 1974, was now on the statute book but implementation was being affected by the present financial constraints. Concern had been expressed about paragraph 39 of Circular 171/74 which in some quarters had been taken to mean an embargo on smoke control programmes. The Clean Air Council had, however, been assured that all justifiable submissions would receive reasonable consideration.

Cost could not be ignored, and an example was the estimated £60m required to fit all cold blast cupolas with proper arrestment plant. The power required to run the plant would be equivalent to the output from six large power stations.

Against this background were the enquiries on the control of air pollution by the Royal Commission on Environmental Pollution. Already the Alkali and Clean Air Inspectorate had been placed under the Health and Safety at Work Commission, a move which the Clean Air Council did not see as being one for the better. The Society had submitted written evidence and would also be giving verbal evidence.

There was at present concern and involvement with International Standards. Different countries had different aproaches, partly because of different national characteristics and partly because of differing requirements. In this country we had evolved a system which suited us and which on the whole worked well. We needed to be certain that any changes were for the better and this would be an important part of the Brighton Conference.

Rear Admiral Sharp said there was still a lot for us to do. He always said that he was working to do himself out of a job, even if only in the field of what might be described as ‘old fashioned smoke control’ but he saw little risk of early retirement—there were still heavy metals, sulphur dioxide, motor vehicles and also aircraft, about which we were to hear that morning.

Finally, Rear Admiral Sharp referred to Mr T. Henry Turner and congratulated him on his 80th birthday on St. Valentine’s Day. Mr. Turner had been a staunch supporter over many years.

The Chairman then introduced the speaker Mr H. M. Clayton, Manager, Manufacturing and Maintenance, Rolls-Royce (1971) Limited, who gave a fully illustrated talk on the RB 211 and the local community.

Mr. Clayton’s paper is not reported but will be printed in the next issue of this Journal.

At the end of the paper an omnibus vote of thanks was expressed by Mr. T. Henry Turner to both Rear Admiral Sharp and Mr. Clayton.

Following lunch, members went to the Rolls-Royce (1971) Ltd. works and were able to see aero engines—the Spey, the Adour and the RB 211 actually being assembled. A visit was also made to one of the production test beds to see at first hand the precautions taken to prevent nuisance from noise and the magnitude of the operation which this involved. A visit was also made to the control room with its many instruments, television scanning and computerised information panel giving the analysis of test results.

This was followed by a tour of P.C.F. (Precise Casting Facility) also referred to in Mr. Clayton's paper. The lost wax process carried on consists of producing multiple built-up patterns in wax which are coated with refractory material to make an intricate mould. After pouring and cooling, the refractory material is discarded. The final castings have a superior finish and great accuracy calling for only minimal subsequent machining.

Finally, over light refreshments provided by kind invitation of Rolls-Royce there was an opportunity to examine cut away sections of engines including a combustion chamber. Members were joined by Mr. G. Strangeways, Executive Assistant to the Managing Director, Mr. C. R. Harris, Chief Legal Officer and Mr. J. Cownie, Public Relations Officer. The warm thanks of the Division for all the effort put in by Rolls-Royce to make the day interesting and successful were expressed by the Chairman Dr. R. V. Riley.

YORKSHIRE

The Yorkshire Division held a very interesting meeting at the works of John Thurley Ltd. at Harrogate on 5th March.

Papers were presented by three members of the staff of Messrs. John Thurley and these have been reproduced in another part of this Journal.

SOUTH WEST

The Annual General Meeting of the South West Division was held in the Pump Room, Bath, on Thursday, 3rd April 1975. Unforunately this was the only meeting held during the year, due mainly to the problems arising from reorganisation, resulting in very few local authority members until comparatively recently. The Divisional Council met in the morning and were able to get through a great deal of the routine business which had accrued during the last twelve months, and the full Division met in the afternoon.

The Division was once again very fortunate in that Rear Admiral Sharp was able to attend and all those present were able to benefit from his address in the afternoon.

The serving officers of the Division were re-elected together with the Divisional Representatives upon the Council. These are: Messrs. T. K. Aston, P. Draper, and the Hon. Secretary.

Reports were received on membership, air pollution monitoring and in particular the Avon/Gloucestershire/Somerset Monitoring Scheme, the Control of Pollution Act and a very full report on matters discussed in the Council and various Committees. A great deal of consideration was given to the problem of membership, and although there are fewer local authority members in the South West Division arising from reorganisation, there is a better geographical coverage. It was however, noted with some regret that the sole local authority representative from Cornwall could not influence the other authorities with whom it amalgamated upon reorganisation to join the National Society. It was decided that all authorities who are not members of the National Society for Clean Air should be contacted in the hope that some of them will in fact be recruited, and it was agreed that these approaches should be concentrated on District Councils.

A programme of meetings for the coming year was agreed, and there are to be three meetings, including the Annual General Meeting. A meeting will be arranged in Plymouth in June or July and it is hoped that the subject of that meeting will be the disposal of toxic waste and the disposal of animal waste, including the control of odours. In October/November it is hoped to visit the Rolls Royce Works near Bristol and look at the problems of air pollution and noise control from aero engines. The Annual General Meeting will continue to be held in March or April and in 1976 it will be held in Bristol.

Rear Admiral Sharp addressed the meeting and it was some comfort to members to learn that since the reorganisation of local government and the reconstruction of the National Society, fewer meetings have been held nationally. It appeared that local authorities and Headquarters are still finding their feet, and that there had been a change of membership and a need for re-recruiting new District Councils. He then referred to changes in the law, in particular the Countrol of Pollution Act and the Health and Safety at Work Etc. Act, and also referred to the Royal Commission on environmental pollution, and that evidence has been given to that Commission as part of this Air Pollution Study. Rear Admiral Sharp then commented upon Circular 171/74, and in particular the concern which had been expressed that this might adversely affect smoke control programmes. He informed the Division that as a result of discussion by the Clean Air Council it was clear that this Circular was in no way intended as an absolute prohibition on smoke control activities. The paragraph was so worded that those local authorities who wished to continue their smoke control programmes, and who could justify such action, could submit proposals to the Department of the Environment. The Clean Air Council had been assured that the Department of the Environment would deal reasonably with any programme so submitted. The Secretary General then referred to the E.E.C. and the move to create international standards for Community Members. He stated that it was important to ensure that new standards are no less stringent than the existing ones, and that it is no use making standards unless they are capable of enforcement. On the question of membership Rear Admiral Sharp stated that over 60 per cent of local authorities in the United Kingdom are members, that most of large industry are members, and that there are a number of highly qualified individual members, thus making the National Society for Clean Air a most suitable forum of a wide variety of views.

The meeting then turned its attention to the main business of the afternoon, which was to receive a paper on the provisions of Part 3 of the Control of Pollution

Act 1974, which deals with noise. The paper was presented by Mr. P. Cooper, M.E.H.A. Senior Environmental Health Officer, Environmental Pollution and Noise Control, of the City of Bristol. Mr. Cooper in his paper outlined the main provisions of Part 3 of the Act and compared the effectiveness of the new legislation with the present legislation. The paper was presented very ably and it stimulated a great deal of discussion. It was unfortunate however that there were no more members present to take advantage of the great deal of information contained in the paper.

However, a revitalised, and it is hoped expanding South West Division, can look forward to a full year of activity and will keep under review the operation of the significant increase in new legislation in the field of environmental pollution which will be brought into operation during the year.

MAXIMUM COST LIMITS

A new Circular from the Department of the Environment has revised the cost limits for appliances applicable under Smoke Control Orders.

The purpose of these limits is to indicate the maximum expenditure (excluding installation costs, except where otherwise indicated) that the Secretaries of State will accept as qualifying for Exchequer contribution in normal circumstances. It will still be for the local authority to decide, within the appropriate cost limit, what costs are reasonable in each case. The limits should not be treated as standard amounts to be accepted without regard to particular circumstances. Where the authority consider that for some exceptional reason a particular limit is inapplicable, they should (as at present) consult the appropriate Department about the amount of expenditure to be regarded as "reasonably necessary".

The authority should apply the new limits, firstly, when dealing with applications in respect of smoke control orders confirmed after the date of this Circular. Secondly, they may apply them, where they think fit, to other cases where applications for the approval of work are received or where work in houses which they own themselves is carried out after this date. They will, of course, wish to ensure consistency in dealing with applications of equal validity. Thirdly, they should apply them to financial estimates accompanying smoke control orders submitted after the date of this Circular for confirmation by the Secretaries of State. Fourthly, they will wish to bear them in mind in their general budgeting for smoke control expenditure to ensure that in 1975/76 this does not contribute to any increase in total expenditure in real terms over that for 1974/75.

The new cost limits in the Appendix are shown exclusive of Value Added Tax. In assessing costs eligible for grant the local authority should take account of VAT where applicable as regards appliances and also for all installation costs. The Secretaries of State will pay Exchequer contributions towards any such tax.

It has also become necessary to revise the maximum cost limit applicable where a coal-burning appliance in regular use with a back-boiler is replaced by oil-fired central heating, or by an oil-burning appliance combining space-heating and water-heating. Grant will continue to be assessed on the lines laid down in Paragraph 7 of Circular No 32/71 (Welsh Office Circular 68/71), but the new maximum cost limits for the oil room heater (£36 excluding VAT) and for replacing the water-heating element (£55 excluding VAT) will apply. Paragraph 7 of Circular 32/71 should be amended accordingly.

Appendix

	ITEM	COST LIMIT excl. of VAT £
1	Improved open fire (including integral gas ignition and where necessary deepening plate and bar)	17
2	Improved open fire (including integral gas ignition and where necessary deepening plate and bar) with boiler	38(a)
3	Underfloor draught fire and fan-assisted open fire	29
4	Underfloor draught fire and fan-assisted open fire with boiler	50(a)
5	Solid fuel room heater	67
6	Solid fuel room heater with boiler	76(a)
7	Gas room heater	34
8	Direct acting electric space heater	25
9	Electrical thermal storage heater	46
10	Oil room heater	36
11	Solid fuel cooker with boiler	187
12	Gas or electric cooker	72
13	Independent solid fuel boiler, **including installation**	55(b)
14	Gas water heater (eg gas circulator and back boiler unit), **including installation**	55(b)
15	Electric immersion water heater, **including installation**	33
16	Gas or electric wash boiler	30
17	Gas poker, including flex and tap	5
18	Bottled gas igniter	14
19	Provision of ignition appliances, **including installation,** per dwelling (not per fireplace)	20(c)
20	Alternative source of heat in certain kitchens, **including installation**	20(d)

NOTES: (a) Up to £12 may be added where
- (i) it would be impossible or inadvisable to connect the existing boiler to the new space-heating appliances, and
- (ii) either a. the existing boiler is itself bower-barffed or made of stainless steel, copper, aluminium, bronze or other superior material,
  - or b. one of the above types is necessary to comply with local water bye-laws.

(b) Notional figure. Because the costs of this type of appliance exceed what is considered reasonably necessary, having regard to the cost of installing an electric immersion water heater, this cost limit has been determined on a notional basis. In assessing grant, VAT based on the cost limit should be added.

(c) See MHLG Circular No 51/65 (Welsh Office Circular 14/65), Appendix II, para 26(10), which should be amended accordingly.

(d) See Circular No 32/71 para 6 (Welsh Office Circular 68/71), which should be amended accordingly.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Spring 1975)** *which gave the position up to* **31 December 1974.** *They now show changes and additions up to* **31 March 1975.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

As from 23 September 1974, the distinction between "black" and "white" areas has been discontinued. Because of this, the table showing the smoke control position in regions of England has been temporarily discontinued.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

West Midlands
Tamworth B.C. (No. 7).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern
Derwentside (Tanfield Lea No. 2), Hartlepool (Nos. 28 and 29), Rotherham (Greasborough No. 4, Rawmarsh No. 6 and Swinton No. 17).

North West
Chorley (No. 1), Hyndburn (Nos. 34 and 35), City of Manchester (Ringway and Woodlands Road), Preston (Areas No. 30, 31, 32 and 33), Stockport (North Reddish/Heaton Chapel).

Yorkshire and Humberside
Calderdale (Ripponden No. 1, Hebden Royd—West End No. 3, and Halifax 20C Lee Bank/Pellon Lane), Kingston upon Hull (No. 14 Newland West), City of Leeds (Metropolitan District) (No. 1 Methley and No. 2 Morley Central), City of York (No. 5).

West Midlands
East Staffordshire (No. 5), Newcastle-under-Lyme (Area No. 9A), City of Stoke-on-Trent (Nos. 29 and 30), Walsall (No. 23 Inner Broadway), Warwick D.C. (No. 2).

East Midlands
Gedling (Nos. 2 and 3), City of Lincoln (No. 10), North Kesteven District (North Hykeham and Skelingthorpe No. 1).

London Boroughs
Barking (No. 16), Bexley (No. 15), Waltham Forest (No. 25), Wandsworth (No. 7).

South East
Gillingham (No. 7), Luton (No. 13), Watford (No. 12 Harebreaks and No. 13 Oxhey Park).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern
Darlington (No. 12 Whinfield), Hartlepool (No. 27), Peterlee (No. 4).

North West
Bolton Metropolitan Borough (No. 2 Farnworth No. 9A), Bury (Tottington No. 5), City of Manchester (Woodlands Road), Oldham (Greenacres/Clarksfield), Rochdale B.C. (Freehold and Drake St. No. 1), St. Helens (No. 10), Trafford (Altrincham No. 13), Warrington B.C. (No. 1 Stockton Heath/Grappenhall), Wigan B.C. (Golborne District No. 4), Wirral (Bebington No. 25).

Yorkshire and Humberside
City of Leeds (No. 121 Holbeck (Brown Lane) and No. 122 Stanningley (Leeds and Bradford Road), Sheffield (No. 28 Stocksbridge No. 3).

West Midlands
Dudley (No. 132 Kates Hill), East Staffordshire (No. 5), North Warwickshire B.C. (No. 1), Nuneaton B.C. (No. 13 Attleborough), Rugby (No. 17), Stoke on Trent (Nos. 29 and 30), Walsall (No. 21 Pelsall and No. 22 Aldridge Consolidation), Warwick D.C. (Nos. 2 and 3).

East Midlands
Ashfield District (Nos. 1 and 2), City of Lincoln (No. 10), Northampton (No. 12).

London Boroughs
Barking (No. 16), Bromley (No. 24), Harrow (No. 32), Lambeth (No. 30), Merton (No. 30), Newham (No. 13), Southwark (No. 31 Surrey Docks), Waltham Forest (Nos. 23 and 24).

South East
Gravesham (No. 1), Guildford B.C. (No. 3), Hemel Hempstead (High St./Piccotts End), Milton Keynes (No. 1 Bletchley No. 4), Stevenage Borough (Area No. 6).

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Belfast C.C. (No. 11 Var).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Antrim D.C. (No. 4), Belfast C.C. (No. 12).

WALES

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Wrexham Maelor (Areas No. 1 and 2).

SCOTLAND

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Airdrie (No. 3), Burntisland (Broomhill), Edinburgh (Liberton No. 1), Glasgow (Partick East and Park), Hawick (Central).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Burntisland (Broomhill), Dunfermline (Pilmuir St./Arthur St.), Glasgow (Partick East), Grangemouth (No. 7).

SMOKE CONTROL AREAS

Progress Report

Position at 31st March 1975

(Figures supplied by the Department of the Environment, The Welsh Office, The Northern Ireland Ministry of Development and the Scottish Development Department).
**Corrected to comply with D.O.E. Belfast figures.*

	Engiand			*Wales*			*Scotland*			*Northern Ireland*		
Smoke Control Orders Confirmed prior to 31.12.74	4,452			19			245			61*		
Acres		1,409,628			2,855			134,441			14,735	
Premises			6,373,246			10,499			559,988			37,120
Smoke Control Orders Confirmed (31.12.74-31.3.75)	47			—			4			2		
Acres		30,013			—			1,719			848	
Premises			95,787			—			4,808			4,961
Totals	**4,499**	**1,439,641**	**6,469,033**	**19**	**2,855**	**10,499**	**249**	**136,160**	**564,796**	**63**	**15,583**	**42,081**
Smoke Control Orders Submitted (31.12.74-31.3.75)	43			2			6			1		
Acres		17,106			25			3,355			—	
Premises			74,447			81			19,451			130
Grand Totals	**4,542**	**1,456,747**	**6,543,480**	**21**		**10,580**	**255**	**139,515**	**584,247**	**64**	**15,583**	**42,211**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

THE MONITORING OF POLLUTION

The Association of Public Health Inspectors is holding a one-day conference on the monitoring of pollution at Caxton Hall, London SW1, on Wednesday, 3 July 1975 at 10.30 a.m.

The purpose of the conference is to discuss the recent report by the Central Unit on Environmental Pollution of the Environment—"The Monitoring of the Environment in the United Kingdom". The report showed that in spite of existing extensive monitoring programmes urgent action is needed to provide a more coherent picture of national pollution trends.

Local authorities will have an increasingly important part to play in measuring pollution. The Association feels therefore that a discussion of this report, will give guidance to local authorities on how best they can design their arrangements for local monitoring of the environment so that the results can be co-ordinated to give an accurate picture of pollution.

The one-day conference will give an opportunity for such a discussion. The speakers will be as follows:

Dr. L. E. Reed, Central Unit on Environmental Pollution, Department of the Environment.

M. R. Tunnicliffe, H.M. Alkali and Clean Air Inspectorate.

Dr. A. E. Martin, Department of Health and Social Security.

A. G. Wilkie, Industrial Hygiene Laboratory, Department of Employment.

Dr. John Reay, Warren Spring Laboratory.

N. J. Pattenden, Environmental and Medical Services Division, Atomic Energy Reserch Establishment, Harwell.

A. Archer, Chief Air Pollution and Noise Abatement Inspector, Birmingham.

Further details regarding attendance may be obtained from the Secretary, APHI, 19 Grosvenor Place, London S.W.1.

The Heating and Ventilating of Buildings by Direct Gas Firing

by

K. H. Smallman

This paper was presented to a meeting of the Yorkshire Division, held at the works of John Thurley Ltd. at Harrogate on 5th March 1975.

The following talk is to outline the relatively new technique of direct gas-fired heating units applied to various buildings in order to perform a combination heating and ventilation function and to comment on the effect that these systems have on the environmental conditions, both internal and external to the heated building.

In the first place we should define exactly what is meant by the term, "Direct Gas Firing". In the context of this talk our definition would be, "The process where a gaseous fuel can be burned directly into a moving airstream and transmit 100 per cent of its available heat energy into that airstream".

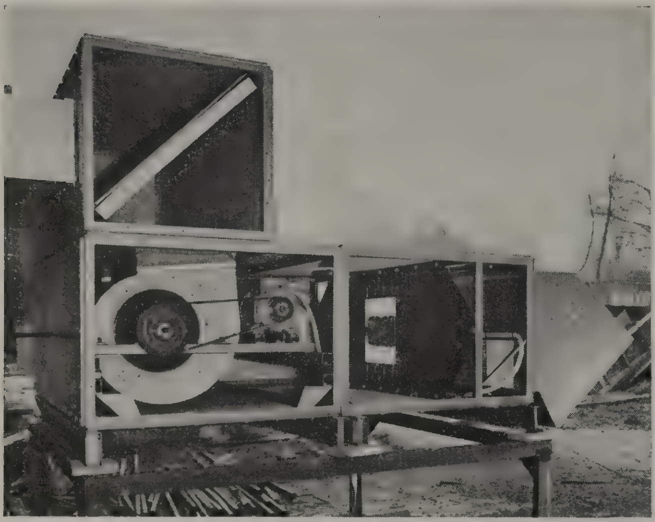


Fig. 1 *Typical direct gas-fired heating unit with side panels removed, showing burner, fan units and filter sections*

A typical direct gas-fired heater unit would comprise a burner section fitted with a gas fuel burner and a supply fan section. The gas burner would be fitted on the intake side of the supply fan unit and be mounted in the airstream in line with a sheet metal profile plate having some means of adjustment. The reason for the profile plate is to introduce an orifice into the airflow system to ensure even airflow distribution across the gas burner and to create sufficient velocity across the profile opening to thoroughly mix the high temperature combustion products and low temperature air passing over the burner. This velocity is designed to accurately proportion the correct amount of air through special stainless steel mixing plates fitted to the burner manifold so that as near perfect as possible combustion can be achieved. This good combustion ensures clean burning of the fuel and maintains minimum pickup of combustion products by the passing airstream. For example, we would expect 2 to 3 parts per million pickup of carbon monoxide and 0·10 to 0·5 parts per million pickup of nitrous oxides. These figures compare very favourably with published International Threshold Limit Values of 50 ppm and 5 ppm respectively. The amount of gaseous fuel supplied to the burner can be varied by means of a motorized control valve and the formation of the holes in the burner mixing plates, which have been progressively developed over 25 years of operating experience, permit a flow variation of up to 25 to 1 enabling the unit to be controlled from simple thermostatic controls with a fully modulating heat output, normal maximum temperature rise being 40 to 45°C. Mixing is so good due to the profile plate that motors and flexible drives can readily be fitted into the airstream after the burner within the supply fan section using standard equipment without any special anti-heat safeguards. The burner is of a modular design, being built up in sections which can be bolted together to form a continuous burner rated at any required heat output. Units have been installed fitted with single burners rated from as low as 40,000 BTu/hr., with a turndown of 4 to 1, to a rated capacity of 13,000,000 BTu/hr, with a full 25 to 1 turndown.

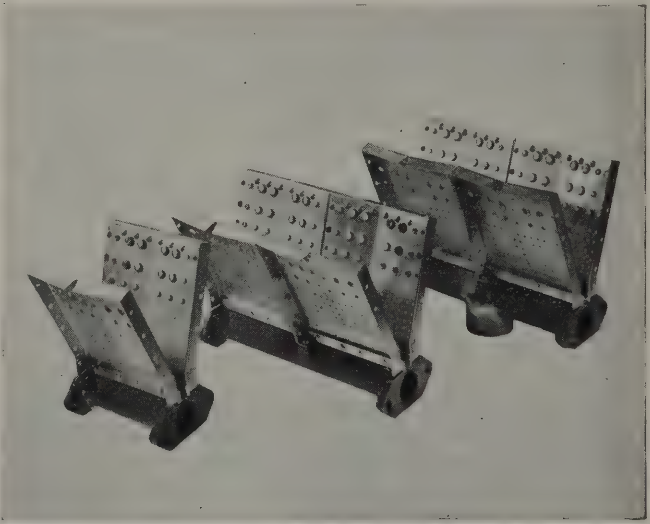


Fig. 2 *Burner sections used for direct gas-fired heating, showing progressively aerated stainless steel mixing plates fitted to gas supply manifold*

To summarize the advantages of using direct fired gas as a heating medium can be expressed as follows:

1 100 per cent of the heat energy is released into the air
2 Gas is a very highly refined, clean-burning fuel
3 Gas can be burned directly in a moving airstream
4 No storage or handling facilities are required

5 An existing network of gas lines is usually available
6 There is nothing in the system to freeze up during shutdowns
7 Gas burners are available with up to a 25 to 1 turndown range
8 The arrangement of gas burner systems is very flexible.

Now that we have considered how direct gas firing in a moving airstream is achieved let us next consider where this type of heating can be used to help the environment inside a building that requires heating.

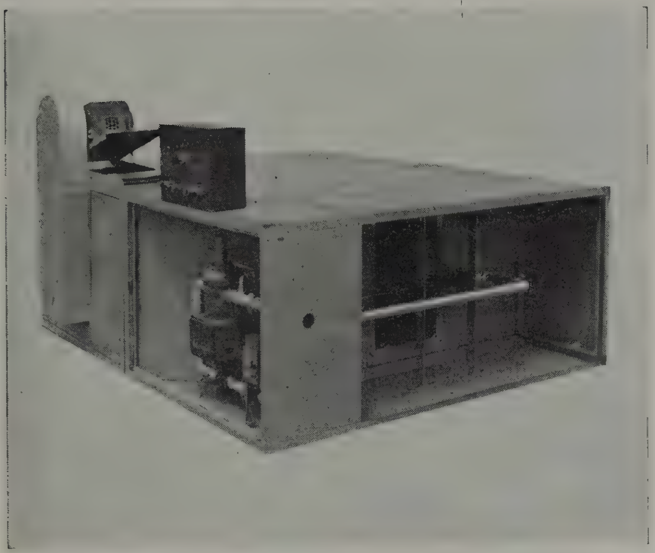


Fig. 3 *Typical direct gas-fired heating unit viewed from inlet, showing burner fitted into profile plate opening and gas control train*

Firstly, we should look at buildings where a process inside the building creates odours or fumes or dust which are intolerable for working conditions. Typical of these would be cooking fumes and odours in restaurants, moisture build-up in swimming pools, smoke fumes in conference rooms, cinemas and theatres, vehicle exhaust fumes in enclosed garages and bus stations, dust in industrial foundries and metalworking factories, fumes and odours in paint finishing plants and chemical works, and many similar commercial and industrial applications. The normal method of dealing with pollutants of this nature would be to provide an air extraction system to the building in order to control the level of pollutants within the enclosure, the amount of air extraction being related directly with the amount of pollutants required to be exhausted. This exhausted air needs to be positively replaced in the building by fresh makeup air in order to provide a balance within the enclosure. Without controlled positive replacement air, personnel working inside the building will be plagued with a host of related problems, including, cold draughts through doorways and window cracks, cross contamination of process pollutants, bacteria and germs, backdraught through extraction ducts, flues, etc., all of these factors leading to uncomfortable working conditions, increased illness of personnel, high rates of enforced absenteeism and low efficiency operation of the plant unit. The basic principle, which should be strictly adhered to, is that for every foot of contaminated air exhausted, there must be added into the building to replace it, one cubic foot of fresh, clean air. Once accepting this principle it can readily be seen that heating of this fresh air is a positive requirement for winter operation, and that the type of heating already described is ideal for this application since we are looking for a heat input to a fresh air stream being used only once through the building without recirculation. This "once through" system ensures no build-up of combustion contaminants above the extremely low levels emitted from the direct gas-fired burner and enables us to take advantage of all the described superior features of this type of heating.

Having determined that direct gas firing is an ideal method for air replacement systems, we can now consider the cases of buildings where there are very low process pollutant emissions or where there is no process taking place. Typical of these applications would be service garages, industrial assembly plants, warehousing facilities, supermarkets, schools, shopping precincts, shops, offices, department stores and public buildings. All of these applications have some degree of fume, odour and moisture emission into the environment and would benefit from the controlled introduction of fresh air into the general atmosphere of the enclosure and the prevention of the build-up of pollutants being emitted at normal low contamination levels, as would be the case using recirculating heating systems. By using direct gas-fired heating units, supplying fresh heated air into the building, the total enclosure can be pressurized and vented by the use of fitted pressure relief grilles, at a low installation and operating cost. In these applications the amount of fresh air introduction can be related to the physical size of the building or to the number of occupants where high density occcupation occurs. All the advantages of a direct gas-fired heating system are available and we are still determining the application as a "once through" system, so that there is no possible risk of a build-up of combustion products, due to the nonrecirculation of room air across the burner.

In order to utilize this type of system to its fullest advantage, variations to the system can be built in to cope with individual applications.

For example, where contaminants are emitted in a small local area of a large building or where even distribution is required in a divided building it is often advisable to introduce exhaust air systems to certain areas of the building and adjust the air pressurization rate to cover the additional requirement.

Again, to ensure even distribution, it may be advisable to increase the ventilation air change rate above the design rate for a pressurized or forced ventilation system. This can easily be achieved by introducing recirculation room air into a direct gas-fired system, but only downstream of the fitted burner so that the "once through" principle of fresh air heating by the burner is not prejudiced.

It should be added that a direct gas-fired burner would operate perfectly adequately with a mixed fresh air and recirculation air flow across the burner, but if mixing is affected before the burner the system could be open to operational abuse, and it is therefore considered a necessary precaution that all recirculation room air is introduced downstream of the burner to ensure that there is no possibility of abuse of this type of heating when applied to a recirculation system.

From the above descriptions it can be seen that a direct gas-fired heating system with its efficiency of operation, clean burning characteristics and availability

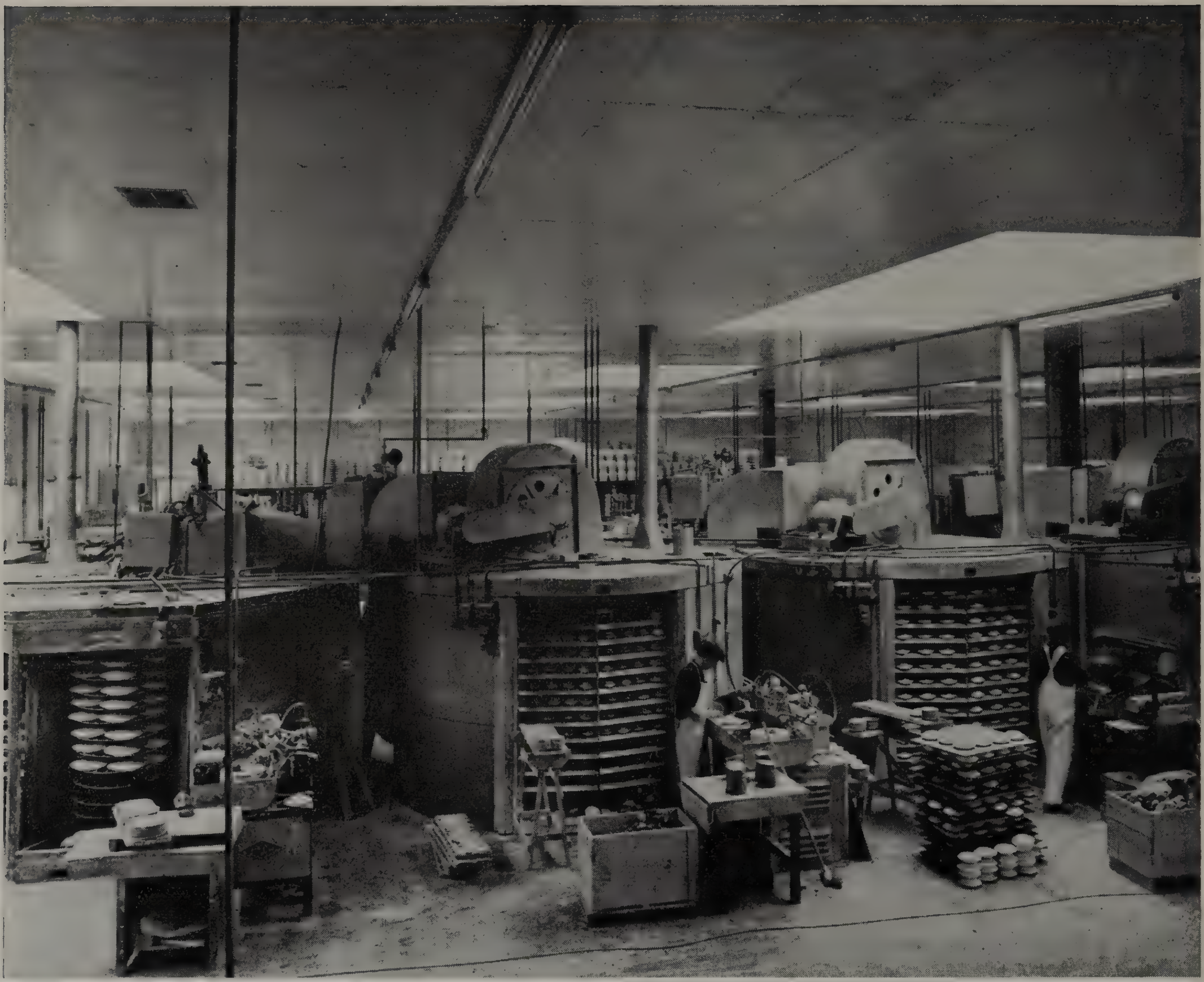


Fig. 4 *General view of Pottery Plant where replacement air for dryers, kilns, spray booths and fettling hoods is direct gas-fired heated and provides total plant heating and ventilation requirements*

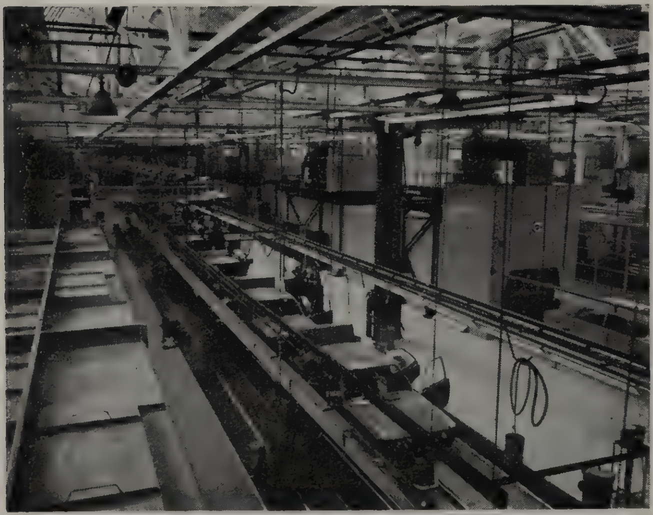


Fig. 5 *General view of auto paint finishing plant, where replacement air for spray booths, dry off and paint baking ovens is direct gas-fired heated*

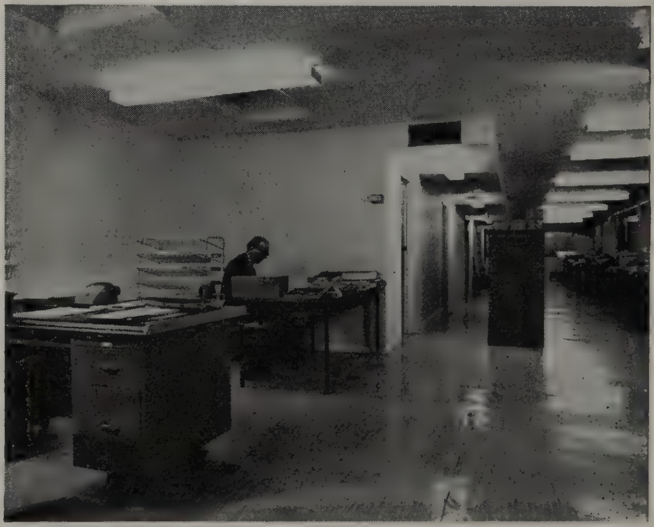


Fig. 6 *Office heated and pressure ventilated by direct gas-fired heater unit fitted with partial recirculation, downstream of gas burner, showing floor supply grilles, recirculation grilles and control space thermostat*

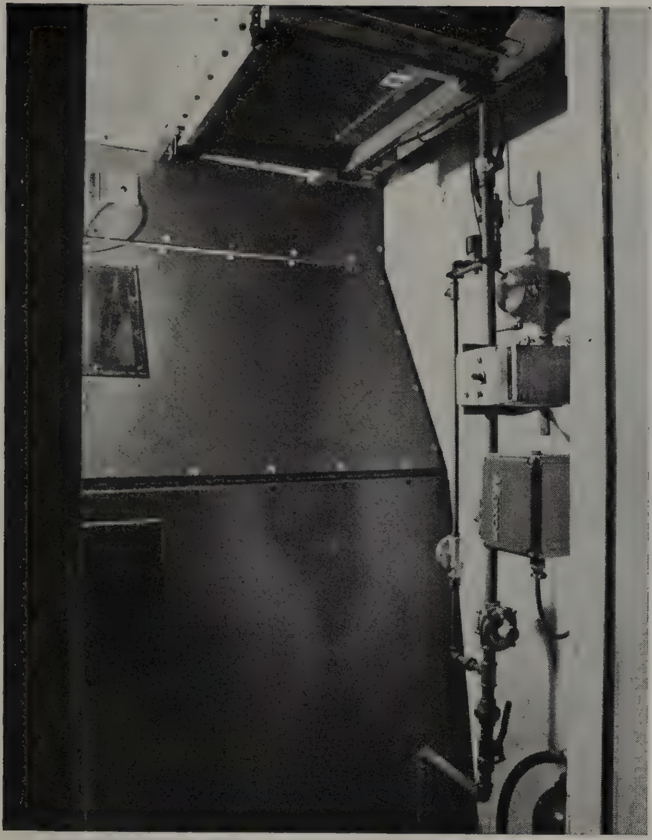


Fig. 7 *View of office heater unit, showing fresh air inlet duct at top, fitted with gas burner, and gas control train at right-hand side*

of modulating temperature control, can be used to control the environment within a building, but what about the external environment?

To this end we have two main considerations for the direct gas-fired heating systems. Firstly, that due to its high efficiency, for any given building heat load the fuel consumption and hence the atmospheric combustion pollutants will be between 25 per cent and 50 per cent lower than for any other form of heating, Secondly, the combustion products from burning the gaseous fuel will be highly diluted with fresh air at source and will not be exhausted to the atmosphere as a concentrated source causing problems with contamination.

In conclusion the effect on the environment of direct gas firing, applied to warm-air heating systems, can be summed up as follows:

1 By comparison with any other form of heating, for the same, or even a decreased, discharge to atmosphere of combustion products, direct gas firing allows the introduction of increased fresh air quantities to an enclosed building, ensuring an improved internal environment.

2 For a given heat load to maintain a conditioned environment within an enclosed building, direct gas firing, when compared with any other form of heating, consumes less fuel and hence decreases the amount of combustion products released into the atmosphere.

Do You Care About The Environment?

Is it economic to recycle waste paper? Is Britain about to face a serious water shortage? How can we improve our methods of dumping industrial waste?

These are some of the questions posed by the Open University's course Environmental Control and Public Health.

The course is designed for anyone concerned with environmental issues and should also be of specialist interest to people in the environmental health field, pollution control experts, engineers and planners.

The course aims to show how the disposal of solid wastes and sewage should be viewed in the overall context of resource management.

For example, in future Britain may well have to obtain a lot more domestic water from rivers. They, in turn, will have to be cleaned up, and toxic wastes will have to be kept well clear of rivers.

Parts of the course deal specifically with pollution by air, and noise, as well as water pollution. Ways of avoiding pollution of this type are suggested.

During the course students can test for themselves levels of water, air and noise pollution. The home experiment kit includes a dissolved-oxygen meter, a comparator, a sulphur dioxide/smoke stain apparatus and a sound level indicator. A slide viewer will be included to show students examples of airborne damaged plant life, and the relationships between water life and degree and type of pollution.

In another part of the course, dealing with domestic refuse disposal, the need for recycling is stressed and some indication is given of recycling of refuse that could take place on a wider scale than at present.

Another important strand in the course is an examination of past, present and proposed legislation in the field of environmental issues.

The course is one of the 14 Open University Post-experience courses—all of which can be taken singly—being offered in 1976. It will be the second time the course has been presented. Post-experience courses are designed for people who wish to update or extend their knowledge in a particular area.

As with other Open University courses, no previous qualifications are needed before taking Environmental Control and Public Health. Students who are successful both in assignments and the optional examinations at the end of the course will receive a course certificate. This certificate may count as a second level half credit towards an OU BA degree, for which six credits are required.

Material for the course is contained in a series of correspondence texts which are sent to the student's home. They are linked to eight television and 16 radio programmes.

The course will run from February to November 1976 and the application period runs from 1 May 1975 to 24 October 1975.

The Post-experience courses prospectus, together with application forms, is available from the Post-experience Student Office, Open University, Walton Hall, PO Box 76, Milton Keynes, MK7 6AN.

INDUSTRIAL NEWS

Catalytic Converter Production at Cheswick & Wright

The first catalytic converters for British-made cars are now being made by Cheswick & Wright, part of TI Silencer Group, at its Blackpool plant. Special manufacturing facilities have been installed for this work.

The stainless steel catalytic converters will be fitted by British Leyland to cars exported to the U.S. They will enable British Leyland cars to comply with the U.S. Environmental Protection Agency regulations which come into force in 1975, governing the amount of hydrocarbons and carbon monoxide to be emitted from exhaust systems.

Photograph shows final assembly of a catalytic converter unit.

Reader Enquiry Service No. **7554**

Dust Control at the GLC's Newham Refuse Tipping Plant

At the Greater London Council's refuse tipping station at present under construction at Newham, road vehicles will discharge refuse into six specially designed refuse tipping bays. The generation of dust and fumes is an inherent feature of this operation and dust control plant manufactured by Midac Dust Control of Birmingham is to be installed to collect and handle the dust generated.

The equipment to be supplied by Midac includes two pairs of extract hoods per tipping bay, the hoods from the first three bays being connected to a main extract header which will then be ducted to a Midac wet dust collection unit fitted with an automatic sludge removal conveyor.

Midac Dust Control is also to supply the twenty-four extract hoods required in the installation, the exhaust ductwork and the electrical control equipment.

Reader Enquiry Service No. **7555**

Buell Win Contract for £200,000 Sewage Incineration Pilot Plant

A £200,000 contract for a sewage sludge incineration pilot plant has been awarded by the Upper Tame Water Reclamation Division of the Severn Trent Water Authority to Buell Limited, specialist designers of industrial drying plant and systems.

Buell Limited, a subsidiary of Lodge-Cottrell Limited, are to engineer and install a rotary kiln type pilot plant at the Division's Coleshill Works which will enable the process of heat drying and incineration of wet sludge in a single unit to be assessed and compared to the alternative forms of sludge disposal.

At present the common practice in the U.K. is to air dry sewage sludge, but with the volume increasing by at least 3 per cent per annum the availability of land is of major concern to all municipal authorities. Incineration can reduce sludge to a very small volume of inert ash suitable for tipping on to reclaimed land.

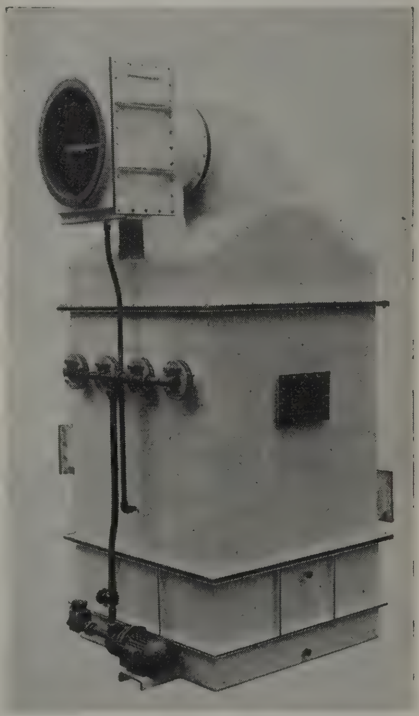
Buell are also installing one of their specialised fluid bed incinerators alongside the rotary kiln and field experience in the operation of both plants is expected to provide valuable information with regard to sewage sludge disposal utilising these two units.

Reader Enquiry Service No. **7556**

Fume Scrubber Units

A new range of fume scrubber units, principally to meet the demand for an effective method of treating metal finishing acid fumes, have been introduced by Rodway & Taylor (Birmingham) Limited. These units are particularly effective when used on Nitrous bearing "phosbrite" type fumes, where the unit's relatively large volume retains the gases sufficiently for more of the less soluble NOx compounds to be eliminated. Chromic and other acid compound fumes have also been successfully treated.

The units are constructed in PVC reinforced externally with glass fibre. PVC polythene and Polyethylene are used on integral components. An integral caustic sump with a sight glass and fittings form the base of the scrubber, while a multi jet spray system provides a uniform "wet" area on the high area mesh section. Prior to the fume exit a mist eliminator removes surplus airborne particles. The standard pump unit is an all stainless steel centifugal type, but actual specifications vary with the application.



Resistance of these units is noticeably low, falling to 1½in w.g. pressure drop. Installations are successfully treating toxic fumes in Denmark, Belgium, South Africa, Singapore, Hong Kong and of course in the U.K.

Reader Enquiry Service No. **7557**

Construction site could become sailing centre

Far reaching after-use plans for the first fully operational concrete oil platform construction site in Scotland are already being offered for discussion by the contractors. Plans put forward in a recent report on the possible after-use of Ardyne Point include an international sailing centre, a fish farm or an education and recreation centre on a national scale.

The report follows the start of an extensive landscaping programme designed to soften the impact of the construction site on the Kyles of Bute landscape, long considered an outstandingly beautiful area.

Contractors Sir Robert McAlpine & Sons Ltd commissioned the report from Inland and Waterside Planners, who now want a working party formed among land owning, industrial, commercial, educational and environmental parties to discuss the options offered. Its end should be to establish a management framework to anticipate, develop and possibly manage the after-use of the site round the coast.

The report is the first published after-use plan for a North Sea Oil related site. Its subject, Ardyne Point, has been the centre of considerable controversy ever since McAlpine announced its plan to construct three giant concrete oil platforms on former coastal grazing land. McAlpines are pledged, if required, to the total restoration of the site, but as an alternative to the land returning to ' the sheep and seagulls ' Inland and Waterside Planners suggest making use of the costly civil engineering already undertaken and turning it to the advantage of the environment.

Their report makes a strong case for converting one of the three platform construction basins into a yacht harbour to help develop the Clyde's potential as an international sailing centre. A second basin would be used to sail-train novices who would eventually graduate to the yacht harbour and then to the Clyde itself. The sail centre is the focal point for a total scheme for an educational and adventure centre for families on self-catering holidays. As an alternative to a recreation area, Inland and Waterside Planners propose using the area for both land and marine farming. Two basins would be used for stocking fish and the third for oyster culture. The grazing land now excavated would be filled and returned to cattle use.

Yacht harbour

The report also states that it would be possible to combine both options for after-use, providing a mixture of both social and commercial enterprise at a cost similar to that of reinstating the site to grazing land.

Initial landscaping work has already begun to ' soften ' the McAlpine site at Ardyne, with an artificial hill created from excavated spoil now being planted with trees. The hill overlooks the platform site and reduces the impact of high rise construction work and equipment on the skyline.

Reader Enquiry Service No. **7558**

Pollution-control Process Wins Queen's Award for British Aluminium

The Queen's Award to Industry for technological innovation has been conferred on The British Aluminium Company Ltd for a process that is making a significant contribution to world-wide control of atmospheric pollution and to improving metal quality.

The process, which was developed by the Chalfont Technological Centre of British Aluminium at Gerrards Cross, Bucks., obviates the use of chlorine in cleaning and de-gassing liquid aluminium. Before being cast either to final shape or for subsequent fabrication into wrought products, aluminium must be de-gassed and cleaned in the liquid state. This prevents defects and surface blemishes in the final product arising from porosity and inclusions. Traditionally, the de-gassing and cleaning operation is carried out in a holding furnace by passing chlorine or chlorine compounds through the liquid metal, an operation which causes much noxious fume and dross formation.

The new BA process, called Fumeless In-Line De-gassing (FILD) employs harmless nitrogen gas under a salt-flux cover to de-gas and clean a moving stream of liquid metal. This avoids normal treatment with chlorine gas in a holding furnace and the need to install expensive fume-scrubbing plant.

The FILD process is carried out in a single unit, sited between the melting/holding furnace and the casting station and because the process is continuous, the normal delays incurred during treatment in the holding furnace are eliminated. Equipment is available for treating metal at flow rates of less than 200 kg/min up to rates in excess of 600 kg/min and thus the process is equally suited for the small remelt cast shop and the large smelter operation.

FILD is already in use in British Aluminium's factories in the United Kingdom. Licences have also been granted for the use of the process in the United States, Australia, Canada, Finland, France, Germany, Holland, Japan, Norway and the Philippines. It is estimated that about one million tonnes of aluminium have so far been treated for continuous and semi-continuous casting operations. This world-wide experience has proved that there are significant operational cost savings over conventional techniques. Other savings include reduction in metal loss in the form of dross and increased throughput potential because of the continuous nature of the process.

But the most important feature is the ability to de-gas more effectively than with chlorine treatment and simultaneously to clean metal produced from up to 100 per cent dirty and oily scrap to the highest standards. British Aluminium is offering joint process know-how and patent licences for the adoption of FILD by other cost-conscious organisations wishing to avoid the use of toxic gas while maintaining high levels of metal quality or solving existing metal-cleanliness problems.

Reader Enquiry Service No. **7559**

New Process for Weatherproofing

Over the last 30 years the statue of Annie, Lady Jerningham, by the Italian sculptor Penachini, has been on view to tourists and citizens in Berwick-on-Tweed only four months each year, spending mid-September to mid-May in a straw cocoon under an ugly black tarpaulin shroud to protect it from the ravages of the Berwick winter.

But now the delicate, exquisite beauty of the white carrara marble depicting the lady and her two dogs can be enjoyed all the year round, thanks to a British invention. This solves the problem of depth impregnation of marble with a special weatherproofing compound, and forms the subject of a number of pending British and foreign patent applications.

A Balvac team from Balfour Beatty & Co Ltd (a BICC company) treated the statue using the new process, impregnating the marble in depth with a special silicone and organic silica combination supplied by Goldschmidt Ltd. This is expected to protect the marble against the weather for at least 20 years and, probably, for more than 50.

The BBC-1 "Tomorrow's World" team filmed the operation, which was started only at 10.30 a.m. and completed by 3.30 p.m. including a two-hour period while the statue was left to undergo de-aeration. The process was witnessed by a number of observers from the Department of the Environment and the Conservataion Department of the Victoria & Albert Museum. Weatherproofing of stone is very much in the limelight in this Year of European Architectural Heritage.

Reader Enquiry Service No. **7560**

Municipal Incinerator Cuts Pollution and Cost to Ratepayer

The municipal refuse incinerator at Meltham in Yorkshire is providing domestic ratepayers with an annual windfall of over £3,000 from industry, thus making operation and maintenance of the plant increasingly self-supporting. Designed and built by The Incinerator Company Limited of Eaton Socon, Cambs., the plant at present deals with 35 tons/week of domestic refuse, and 20 tons/week of industrial waste including plastics with high calorific value. Further contracts with industry and with neighbouring authorities will increase throughput and income. Disposal of refuse was formerly by tipping on a nearby 22 acre hill-top site.

The incinerator is of three-chamber design with water trough dust catcher to ensure nil emission of fly ash or smoke via the 60ft stack. This is of steel, refractory-lined for its full length. Provision has been made for coupling a waste heat recovery boiler at a future date to harness some of the 14 million Btu/h generated.

One of the main advantages of mixing industrial and household refuse is that industrial refuse of good calorific value can be fed into the furnace prior to the first delivery of household refuse, so providing a good bed of burning material for the low calorific household refuse. A good combustion rate can be maintained throughout the day by mixing the industrial and household waste. In practice this has led to a very considerable reduction of fuel oil for both ignition and after-burning. The main chamber is rated to deal with $1\frac{1}{4}$ tons of refuse per hour.

Reader Enquiry Service No. **7561**

Heenan Environmental Systems

The launch of Heenan Environmental Systems as a separate company finds it in good heart, orders currently being processed having reached a figure in excess of £6m. This satisfactory total was reached by the winning recently of two substantial contracts which together amount to some £600,000. These cover a fluidised-bed incinerator for the disposal of sewage sludge for the Royal Borough of Caervarnon and a complete refuse handling system for a high-density municipal-refuse baling plant to be supplied by Murphy Solid Waste Systems to the City of Glasgow.

Both contracts represent new concepts in their respective fields as the fluidised bed incinerator for Caernarvon will be the first to be built in Britain and the high-density baling plant for Glasgow the first in Europe.

The disposal of sewage sludge is a rapidly growing problem and the fluidised-bed incinerator the company has introduced is not only one of the most efficient methods of disposal, but does so without impairing the environment in any way, the emission of smoke, dust and odours being totally eliminated. The plant for Caernarvon will be built in association with Templewood Hawksley Activated Sludge and will be commissioned early in 1976. Consultants for this project are J. D. and D. M. Watsons of High Wycombe.

High density baling of municipal refuse has been developed to reduce the cost of transport to tipping sites adjacent to major cities. Collection vehicles bring the waste to the baler in the city centre from which the densely compacted bales are transported to the tipping sites.

For Glasgow, Heenan Environmental will supply, in addition to the refuse handling system, a magnetic separator for the removal of ferrous metals, plant for baling the reclaimed metal, and dust removal and fire-fighting equipments. Prime contractors for the project are Murphy Solid Waste Systems and the consultants are Merz and MacLellan of Newcastle-on-Tyne.

Heenan Environmental Systems is one of the Redman Heenan International group of companies.

Reader Enquiry Service No. **7562**

De-gassing Tower in GRP

When Ardleigh Laminated Plastics Company Limited quoted to construct a 23ft 9in high de-gassing tower in GRP, in competition with mild steel construction—not only did they win the contract, but delivered in seven weeks from the date of the order.

This time factor, which included design, customer inspection and site delivery, highlights just one of the benefits of using glassfibre reinforced plastic over traditional construction materials.

The de-gassing tower, commissioned by Davey Water Engineering Limited, of London, for Thames Board Mills Limited, of Warrington, Cheshire, and installed in their Power Dept., was constructed generally to British Standard 4994 (vessels and tanks in reinforced plastic).

The tower itself is now used for cleaning acidic waste gas (P.H. 3 to 6) held at ambient temperature and atmospheric pressure.

The 42in inside diameter tower consists of two sections—the top 9ft 6in, bottom 14ft 3in—with gas fed in at the top of the lower section through two pvc pipes which are moulded integrally into the shell. Water is sprayed into the top section which is filled with Rachid rings up to the water inlet pipe near the top of the tower, so increasing the surface area for efficient cleaning of gases. Cleaned gas is then ducted to atmosphere through the top cover.

There are several benefits in using GRP over steel construction both structurally and economically. It's resistance to corrosion from chemicals, heat and weather and water, makes it virtually maintenance-free. Additionally, it has a high strength to weight ratio and excellent impact resistance.

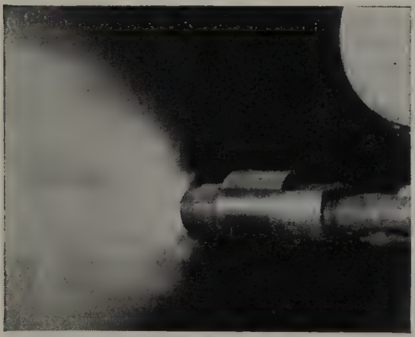
Installation is easier than with steel as its relatively light weight means it can be erected or installed without excessively heavy lifting equipment and by a small work crew.

Ardleigh Laminated Plastics Company Limited have specialised in supplying GRP tanks and vessels and protective coatings and linings manufacture for 11 years and now have a wide range of experience from which to draw.

Reader Enquiry Service No. **7563**

Gas Cooling Problems Solved by Sonic System

Traditionally designed evaporative gas cooling systems for smelter and furnace off gases can pose many operational and maintenance problems. International Nickel Company of Canada Ltd. ran into such problems at its new nickel refinery at Copper Cliff, Ontario.



The original cooling system used 15 pressure atomising nozzles operating at 100 pounds per square inch with a banking type control circuit to modulate total cooling water flow to the chamber. The degree of atomisation obtainable with pressure nozzles was insufficient to provide complete evaporation and wet bottom operation was necessary. A wash system was installed in the chamber hopper to minimise wet material buildup. An estimated three times theoretical cooling water flow was sprayed into the chamber with an additional flow due to the wash system. The excess water was allowed to run off through a hopper bottom drain. This runoff had an excessively low and erratic pH, causing pH control problems in the plant's waste water treatment system while overloading that system with solids and dissolved metals. Additional problems were experienced in the form of refractory spalling which caused plugging of the drain line.

The spalling problem was resolved in part by changes in the type of refractory used. Resolution of the remaining problems has now been accomplished by conversion to an effective dry-bottom, dry-outlet system supplied by the Environment Systems Division of Sonic Development Corporation.

The sonic atomising nozzles inject finer droplets, i.e. less than 200 microns, which evaporate completely to provide rapid cooling, reduced water consumption and dry-bottom dry-outlet operation.

At Copper Cliff, Inco's engineers installed three sonic nozzle assemblies in the inlet duct of the cooling chamber to ensure maximum residence time for the droplets and to avoid contact with the refractory inner lining of the chamber. The control system was also upgraded to take advantage of the wide turndown or flow modulation capability of the nozzles. Sonic's cascade feed forward control system modulates both air and water pressure to the nozzles to inject only the amount of water needed for cooling despite fluctuations in inlet gas temperature and volume. Outlet set-point temperature is now held at 350°C ± 5° compared with ± 45° previously.

The Results:

1. A substantial reduction in the cooling system's water consumption.
2. Improved pH control in the plant's thickener and a major reduction in reagent costs.
3. Reduced dissolved metals in the plant's waste water system.
4. Reduced suspended solids for the plant's thickener to handle.
5. Elimination of refractory spalling problems.
6. Lower maintenance costs for the cooling system and its related components.
7. Increased plant output due to reduced cooling system downtime.

Reader Enquiry Service No. **7564**

BOC Cupola Bed Ignition System Cuts Fumes

Smoke and fume extraction problems faced by the foundry industry are being reduced, often dramatically, by increasing acceptance of a cleaner method of igniting cupola-type furnaces.

The system being used is an air propane burner technique established by BOC some years ago.

But now, because traditional methods of lighting the cupolas with timber and oil waste either causes smoke pollution or is becoming uneconomic, the BOC system is gaining wider use.

Many foundry companies in the Midlands and the North have recently adopted the BOC system and are reporting less smoke pollution and swifter lighting-up times for their cupola furnaces.

An air propane burner can be used to ignite the coke bed in any size of cupola. The problem of smoke pollution caused by the traditional use of timber or oil waste is heightened because, historically, cupolas tend to exist in built-up areas.

Additionally, foundries are now finding it increasingly difficult to obtain timber. Even when bought it is expensive, takes up valuable storage space and is often slow to ignite.

BOC markets the gas burner system as a package, consisting of regulator, hose, manifold and propane cylinder.

Firms now using it say that it has considerable benefits. For example, Bill Johnston, general manager of Starkeys Technicast at Hull, says: "Since the burner has been used to light the cupola, it has cut down considerably on the amount of smoke emission and no complaints have been received locally. It has also taken at least half-an-hour off the cupola lighting time."

Michael Worsley, foundry manager at Bingley Foundry, Yorkshire, also confirms that its use has overcome the foundry's previous smoke emission problems.

S. Walker & Sons Limited, Mansfield, have a small coal blast cupola with a melting rate of two tons per hour. Paper, sticks and coal or coke from the blacksmith's fire were used for lighting the furnace before propane. Managing director, Richard Webster, says: "The BOC propane method is simpler and cleaner."

S. Walker also use it as an after burner to fire the fume emission from each charge of scrap and coke. The burner has cut down the smoke emission by at least 50 per cent.

Reader Enquiry Service No. **7565**

Parkray Bring in Biggest Output Solid Fuel Room Heater

On show to the public for the first time on the Solid Fuel Advisory Service stand at the Ideal Home Exhibition, Olympia, 4 March, 1975, was the new Parkray solid fuel room heater—the One Eleven GT. This new high-output solid fuel room heater provides whole house central heating with up to ten radiators (225 sq ft radiating surface) and domestic hot water. The boiler output is 40,000 Btu/h and has a space heating output of 6,500 Btu/h to the room in which it is fitted.

The One-Eleven GT has the aproval of the Domestic Solid Fuel Appliance Approval Scheme and is in the 'List of Approved Domestic Solid Fuel Appliances' issued by the Solid Fuel Advisory Service and the Solid Smokeless Fuels Federation.

Suitable fuels include Sunbrite Doubles, Welsh, Dry Steam Coal, Large and Small Nuts—M or S Size, Anthracite Stove Nuts, Phurnacite.

Reader Enquiry Service No. **7566**

Money-Saving Tips from British Gas

A new booklet called "Save Gas Save Money", recently published by British Gas, draws together hints as to how domestic users can reduce their own gas consumption and help the energy conservation drive.

Natural gas is a highly efficient fuel which already supplies some 30% of Britain's useful heat—in the domestic sector this may rise to about 50%. With all its attributes, natural gas is too good to waste. Every therm wasted means a costly addition to fuel imports. Every therm saved reduces the oil import bill by making more gas available for other uses. The tips in this booklet show how to avoid waste as well as reducing domestic gas bills.

The booklet is divided into two parts—firstly showing how to make immediate savings in cash as well as by using gas more widely; secondly, advising where spending a little can produce savings in the long term.

In the first area, a major point is for customers to ensure they are on the best tariff for their particular consumption—for example, buying a lot of gas through a pre-payment meter is more expensive than if it were bought on a credit tariff. Among other points to help save gas and money is advice on:

- Thermostat and control settings, so that reductions can be made in the use of central heating, while maintaining comfort.
- The economic use of hot water in kitchen and bathroom.
- Where savings can be made in the use of gas cookers and refrigerators.

A particular point where small investment can make significant savings is by installing roof insulation. Other points where investment can be an advantage are:

- New appliances are more efficient than old ones.
- Servicing gas appliances regularly keeps them at peak efficiency and prevents waste of fuel.
- Installing double-glazing or wall-cavity insulation.

The heat losses caused by major draughts can be prevented by the use of metal or adhesive foam draught-excluders. But the booklet stresses that all fuel-burning appliances must have an appropriate supply of fresh air to work properly, so when draught-excluders are to be fitted it is essential to check that there is adequate ventilation for all gas appliances in the room.

The booklet also invites readers to send in other tips they think would save gas. The address is: Savings, British Gas, London W1A 2AZ.

Copies of "Save Gas Save Money" are available, free of charge, from British Gas showrooms.

Reader Enquiry Service No. **7567**

Burning Refuse Saves Fuel

The first U.K. refuse pulverisation plant specifically built to save coal is being supplied by Newell Dunford Engineering Limited and is to be installed in Birmingham.

Imperial Metal Industries (Kynoch) Limited are purchasing a Tollemache pulverisation plant capable of treating 40,000 tons of refuse a year. The process shreds the refuse into a homogeneous material which is then suitable for burning in IMI's existing coal fired power stations without polluting the atmosphere. The West Midlands Metropolitan County Council will be supplying the untreated rubbish.

This venture has two distinct advantages, it will make significant savings on IMI's fuel requirements and at the same time enable WMM County Council to dispose of 40,000 tons of refuse a year hygienically and without involving capital and operational expenditure.

The new pulverisation station includes reception hopper, feeder, a 15 ton per hour Tollemache vertical shaft refuse pulveriser, discharge conveyor and one electro-magnetic separator for reclaiming ferrous metals. The plant is due for completion in September 1975.

Roger Kingdon, Chairman and Managing Director of Newell Dunford, stated "Having supplied many Tollemache refuse plants on a worldwide basis we see this development as a breakthrough in one useful method of recycling refuse to produce a valuable end product—in this case energy. When the successful operation is established, we expect that many similar installations will be required."

Newell Dunford Engineering Ltd is part of the Dunford & Elliott Group.

Reader Enquiry Service No. **7568**

CLEAN AIR

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AIR POLLUTION DETECTION

Wherever there is a known or suspected pollution of the atmosphere, a Casella air pollution sampler can detect it; dust, gases, chemicals, bacteria or spores in factories, foundries, mines or laboratories. Instruments are available for short or long period sampling for microscope, gravimetric or chemical analysis. All are simple to operate, and are compact, robust and reliable.

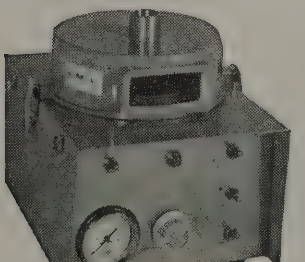
Casella instruments have been developed in co-operation with the Mining Research Establishment of the National Coal Board, the United Kingdom Atomic Energy Authority, the British Cast Iron Research Association and with leading British industrial hygienists. Several instruments are certified as intrinsically safe for use in explosive atmospheres.

Casella samplers are used widely throughout the world – setting the standards for comparison in many countries.

Facilities for the evaluation of samples are available from consultants.

Write for Air Pollution Catalogue 930/1-10.

The Personal Air Sampler provides the most reliable method of measuring airborne hazards to which a wearer is exposed during working hours. Samples are taken continuously for up to 10 hours. The instrument is compact, robust, lightweight and does not impede work. More than 10,000 are in daily use. Ask for leaflet 930/5.



The Bacteria Sampler draws air in known volume onto an agar surface rotating at one of three pre-set speeds. Models cover a flowrate of 30 litres and 700 litres per minute to permit sampling of variable concentrations. This unit is widely used by pharmaceutical, dairy product and food manufacturers. Ask for leaflet 930/7.

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CW CA4

Reader Enquiry Service No. **7569**

If the atmosphere is TOXIC

uei detect and warn...

The increasing use of toxic chemicals in industry with the hazard of accidental leaks, spells danger to the health of personnel. Universal Environmental Instruments specialise in the production of instruments to detect and monitor minute traces of toxic gases – and warn of their presence.

For Continuous Monitoring...

Instruments in the UEI 7000 Series monitor working atmospheres for the presence of toxic gases. They incorporate audible/visual alarms activated when concentrations exceed pre-set levels and have facilities for recorder outputs. Based upon a dry, sensitive paper tape principle, these models are simple to use and provide continuous, inexpensive operation. The new Model 4000 (M.C.M.) is a light, personal unit to provide a profile of individual exposure to TDI or Phosgene throughout an eight hour working shift. With this instrument "spot" atmosphere tests may be made.

For Spot Checks...

The UEI Portable Automatic Sampling Unit is designed for routine spot-test measurement of toxic substances in the atmosphere. It is a completely self-contained aspirating system available in two models for high and low volume samples. Tapes responding to Hydrogen Sulphide, Phosgene, Nitrogen Dioxide, Chlorine, TDI, Vinyl Chloride and Sulphur Dioxide are already available for use in both instruments and further tapes are in course of development.

If you have a responsibility to protect personnel from the hazards of toxic chemicals, we have the systems to meet it. Send for our literature – write now!

uei

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Reader Enquiry Service No. **7570**

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Operating together, the NC Bischoff and Elbair units can eliminate both direct and secondary fumes

The large pressure differentials found in high top pressure Blast furnaces allow the high-energy NC Bischoff unit to clean to very low levels. Also heavily contaminated oxygen blown steel furnace gas streams can be cleaned well below the statutory limit with minimum energy requirements.

The NC Elbair membrane/venturi washer uses the rebound principle to scrub large and widely fluctuating gas volumes from open hearth, blast and arc melting furnaces, from mills, pulverisers, driers etc. In addition the NC Elbair unit will purify oxygen blown furnace fumes escaping into production areas, with pressure losses of only 3-5″ WG

NCE have solutions to all your pollution problems – let us do your dirty work for you!

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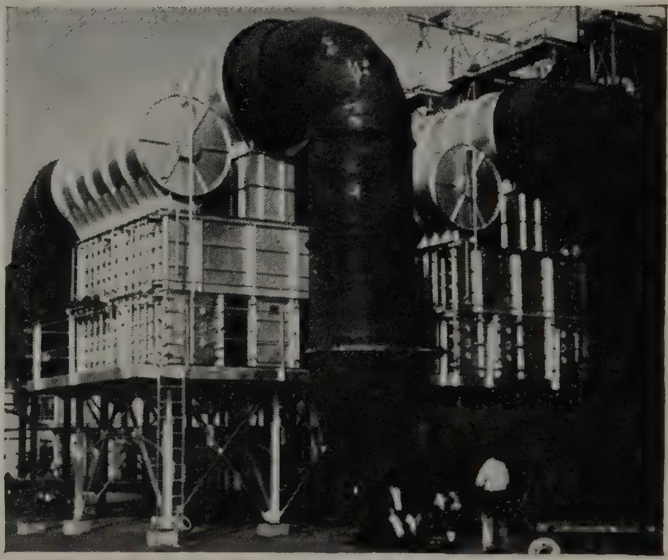


Reader Enquiry Service No. **7571**

CLEAN AIR

Change to Solid Smokeless Fuel

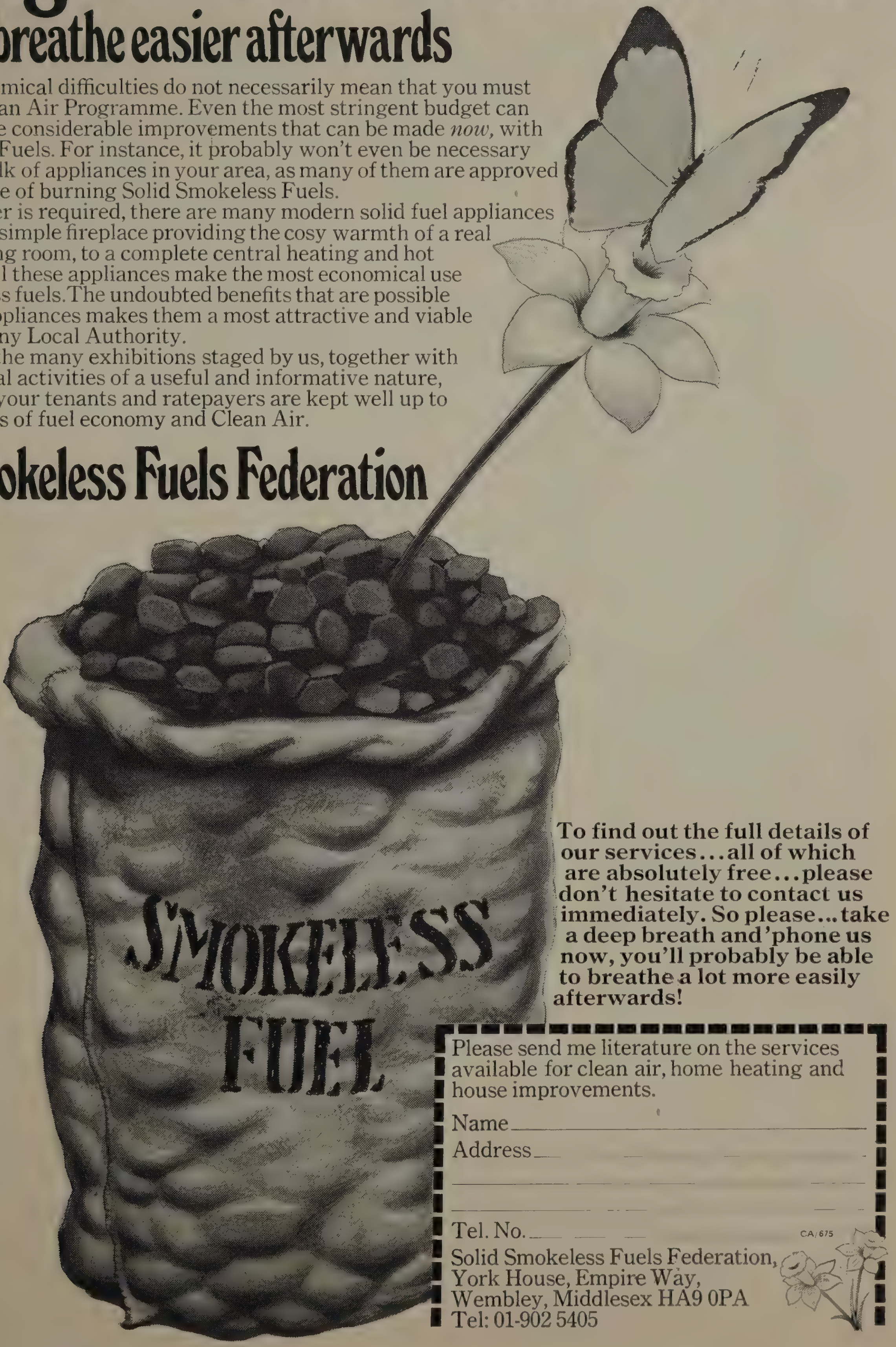
You'll breathe the easier afterwards

Current economical difficulties do not necessarily mean that you must postpone the Clean Air Programme. Even the most stringent budget can accommodate the considerable improvements that can be made *now*, with Solid Smokeless Fuels. For instance, it probably won't even be necessary to change the bulk of appliances in your area, as many of them are approved open fires capable of burning Solid Smokeless Fuels.

If a changeover is required, there are many modern solid fuel appliances available from a simple fireplace providing the cosy warmth of a real fire for your living room, to a complete central heating and hot water system. All these appliances make the most economical use of solid smokeless fuels. The undoubted benefits that are possible with solid fuel appliances makes them a most attractive and viable proposition for any Local Authority.

Additionally, the many exhibitions staged by us, together with other promotional activities of a useful and informative nature, will ensure that your tenants and ratepayers are kept well up to date in all aspects of fuel economy and Clean Air.

Solid Smokeless Fuels Federation



To find out the full details of our services...all of which are absolutely free...please don't hesitate to contact us immediately. So please...take a deep breath and 'phone us now, you'll probably be able to breathe a lot more easily afterwards!

Please send me literature on the services available for clean air, home heating and house improvements.

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Address ____________________

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Wembley, Middlesex HA9 0PA
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Reader Enquiry Service No. 7572

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Reader Enquiry Service No. 7573

CLEAN AIR

AUTUMN 1975
VOL. 5 NO. 19

The Annual General Meeting

Annual Public Meeting, Address given by the President, Professor P. J. Lawther

Some Aspects of Air Pollution on a Global and Continental Scale
J. S. Sawyer

Smoke Control Orders

Rolls-Royce—the RB.211 and the Community
H. M. Clayton

Industrial News

Book Reviews

Now, there's a simple answer to the problem of many factory smells...

People living near factories which produce obnoxious smells resulting from manufacturing processes are living in a polluted atmosphere. Little wonder that the factory becomes the target for continual complaints–either directly from those in the immediate neighbourhood or from the local authority. The simple solution to this basic environmental problem is to remove it!

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The modern and effective method of removing many obnoxious smells is by Engelhard Catalytic Incineration. Working at much lower temperatures than direct thermal units, this method requires far less fuel to operate. A heat recovery system, economising even further on fuel bills, can also be incorporated.

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Accurate observations from pilot test studies form the basis of the design of each Engelhard system. These also establish the optimum operating conditions.

Technical literature or any further information about DEODO air pollution control systems is available from:

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Gloucestershire GL14 2PB Telephone 0594 22181

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air pollution control systems

Reader Enquiry Service No. **7574**

CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

Vol. 5 No. 19 **Autumn 1975**

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Diary of Events

1st October (Wednesday)
London and South East and Central Southern Divisional Visit to the Institute of Sound and Vibration Research
Southampton University

20-24th October
International Clean Air and Control of Pollution Conference (incorporating 42nd Clean Air Conference)
Brighton

5th November (Wednesday)
a.m. Parliamentary and Local Government Committee Meeting
London
p.m. Technical Committee Meeting
London

12th November (Wednesday)
a.m. Conference and Publicity Committee Meeting
London
p.m. General Purposes and Finance Committee Meeting
London

24th November
Copy date for Winter Issue of 'Clean Air'

25th November
p.m. E. Midlands Divisional Meeting
Leicester

27th November (Thursday)
Meeting of the Council of the Society
London

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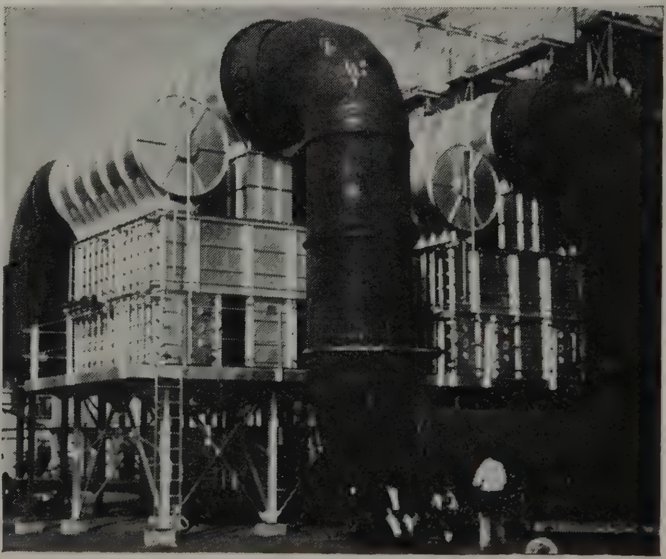

Reader Enquiry Service No. **7575**

"This most excellent canopy, the air"

CLEAN AIR

75th Anniversary

Although the Society was founded in 1899, it was really a year later before it began to become established and effective. It is therefore appropriate that we should celebrate our 75th Anniversary this year. It is also appropriate that a Society whose main tasks have been the dissemination of sound information and the establishment of an informed public opinion about clean air and the dangers of pollution should celebrate its 75th Anniversary by an International Conference on Clean Air and the Control of Pollution.

By a happy coincidence, 1975 has also been the year in which this country has resoundingly reaffirmed its decision to be an active member of the European Community. The Referendum which decided this and the campaign which led up to the vote on the 5th June last are now past history. Much was said on both sides about the advantages and disadvantages, the dangers and the benefits of continuing as a member of EEC. But in the often emotive debate which went on, little or nothing was said about the environment, about clean air and the control of pollution. What was said was that if we remained a member of the Community, we would obviously have to subscribe to its rules and abide by them, even though we would have a very definite say in what these rules should be and how they should be observed. This applies very much to the rules regarding the control of pollution.

At present the nine member States each have their own legislation which they consider suits them best. In the field of air pollution, there are two classic approaches to air pollution control: the 'best practicable means', sometimes called the 'best available technology' approach, and the 'air quality management' approach. In this country, as is well known, we are exponents of the best practicable means; most of our neighbours in Europe tend more to the air quality management approach and it is clear that there are differences of opinion about how the whole problem of the control of pollution should be approached. Brussels and Luxembourg have not been idle and a number of Draft Directives on this subject have been issued. Air knows no boundaries, and this applies whether the air be clean or polluted, and it is therefore essential that the Community should work in harmony over this very important matter.

That this Society recognises the importance of this is signified by the fact that the whole of Tuesday 21st October, the first day of the International Conference at Brighton, will be given over to discussion of this very subject. There will be speakers from this country, from the EEC Directorates concerned and from the Netherlands. This will be an important debate because although in this country we rely on the best practicable means, it is already being recognised by some authorities that standards must be applied. The Greater London Council, for example, have recently agreed guidelines for air quality for the principal pollutants. The Netherlands work on a different system and are evolving a new method for the establishing of standards. Both views will be presented and the debate will be wound up by Professor P. J. Lawther, the President of the Society, an international figure in the field of air pollution control.

A similar pattern will continue throughout the rest of the week. On Wednesday, oil and gas from the Continental Shelf will be discussed. Again, this is a matter of interest not only to this country and to Europe, but also to the world. On Thursday morning the control of pollution from industry will be considered on an international level, and on the Thursday afternoon, the conservation of manpower and resources will be debated. At the final session on Friday pollution from road vehicles will be discussed by speakers from this country and the Continent. This is another subject on which there are conflicting views and a subject on which the views of engineers and technologists are not always heard. But they will be at Brighton.

The subjects that will be discussed at Brighton, at our Anniversary Conference, will affect in the long run, every man, woman and child not only in this country but also in Europe. It is therefore important that you should be there and that you should make your views known. Some of you reading this will already have registered for the Conference, but some of you may not have done so. Full information about the Conference and about registration is given on page 40 of this journal. If you have not registered, may we please say to you 'Do it now'?

THE ANNUAL GENERAL MEETING

The Society's Annual General Meeting was held on Wednesday, 9th July, at the Livery Hall, Guildhall, London. The attendance was very pleasing, with about 100 people present.

Mr R. A. W. Hollingdale, Honorary Treasurer, presented the financial statement for the year ending 31st March, 1975, and was happy to report that generally, in spite of current economic trends, the Society had had a reasonable year financially. Income from subscriptions had increased, which was a very good sign, in view of the fact that because of local government reorganisation it had been necessary to re-recruit all local government members.

The Chairman of the Council, Miss Mary George, C.B.E., then presented the Annual Report, and said that the year under review had been an important one for the environment with new legislation and it was hoped that this would be brought into effect. She praised the Divisions for the work they had done in the background and remarked that they had entered once again on a much more active programme.

The Society had held extremely successful conferences and seminars, and an important feature had been the second Sir Hugh Beaver Memorial Lecture, at which Lord Ashby, F.R.S., delivered an inspiring and memorable address.

Miss George wished to pay tribute to everyone for the support they had given her during her term of office. She was the first woman to hold the position of Chairman of the Society, and although it might well have been by accident that this should have occurred during International Women's Year, it did set a precedent and one which, she hoped, would be followed in the future.

The Honorary Treasurer, Mr R. A. W. Hollingdale, was re-elected for a further year of office.

The following were elected as Vice-Presidents of the Society: Cdr Colin Buist, C.V.O.; Mr John Innes, M.B.E.; Dr Albert Parker, C.B.E.; Mr Stanley E. Cohen, C.B.E., C.C., F.R.S.A.; and Mr T. Henry Turner.

Mr Greenborough speaking, with the new President, Professor P. J. Lawther, on his right.

After the business side of the meeting had been completed, the retiring President, Mr H. B. Greenborough, C.B.E., the Managing Director and Chief Executive of Shell Mex and B.P. Ltd., invested the Society's new President, Professor Patrick J. Lawther, with the Chain of Office as President. Mr Greenborough said that he had had much pleasure and honour in serving the Society as President for the past two years and it was with a sense sadness that he was laying down his office. However, he had nothing but pleasure in being able to pass on his badge of office, a badge of honour, to his friend, Professor Lawther.

Professor Lawther thanked Mr Greenborough for what he had said and thanked the Society for electing him as their President, which was the greatest honour that had been conferred on him in his professional career. He would do his best to serve the Society well.

Mr J. Clancey proposed a vote of thanks to the retiring President, Mr Greenborough, saying that, during his term of office, he had not only furthered the aims and objects of the Society, but had also become accepted as the Society's leader. Mr Clancey added that all members of the Society were delighted to see that Mr Greenborough had been awarded a C.B.E. in the recent Birthday Honours.

The Annual Public Meeting followed the Business Meeting and this also was very well attended. The new President, Professor P. J. Lawther addressed the meeting. His address, entitled 'Air Pollution and the Public Health: A Perspective' is reproduced in full later in this issue.

Chairman of the Council

Miss Mary George, C.B.E., has been succeeded as Chairman of the Council by Mr James Clancey, O.B.E., F.I.P.H.E., F.R.S.H.

Mr Clancey has been Chief Inspector, Environmental Health, to the Greater London Council since the formation of that Authority in 1965, prior to which he was Chief Inspector in the Public Health Department of the London County Council. He previously held appointments with the Royal Borough of Kensington and the Borough of Heston and Isleworth.

Mr Clancey is the present Chairman of the Royal Society of Health, a Vice-President and Chairman of Council of the Institution of Public Health Engineers, a Vice-President of the Environmental Health Officers Association and a member of Council of the Institution of Environmental Sciences.

Mr Clancey has been a member of the Executive Council of the Society for a number of years and has held appointments as Chairman of the Conference and General Purposes and Finance Committees. He is an individual member of the Society. He is also a Liveryman and Freeman of the City of London.

We should like to record our thanks to Miss George for all her invaluable work on behalf of the Society during her term of office. We shall miss her but are glad that she will continue to serve as a member of Council and as a member of the General Purposes and Finance Committee.

The Society's New President

Born in 1921, Professor Lawther was educated at Carlisle Grammar School, Morecambe Grammar School and King's College, London. After spending one year as a schoolmaster he went into the Chemical Industry where he served as a plant chemist, a research chemist and ultimately as chief chemist. He left this industry in 1945 in order to read medicine and in 1950 qualified as a M.B., B.S., of the University of London (St. Bartholomew's Hospital). He subsequently served as a House Physician and was Chief Assistant Research Scholar with the Medical Professional Unit at Bart's. He was Honorary Chief Clinical Assistant at Brompton Hospital and became an M.R.C.P. in 1954.

In July 1955, Dr. Lawther, as he then was, joined the Medical Research Council in order to found the Air Pollution Research Unit. This Unit is now a World Health Organisation International Reference Centre for Clinical and Epidemiological Aspects of Air Pollution.

In 1964, Professor Lawther became an F.R.C.P. and a Doctor of Science of London University in 1971.

He is now the Physician in charge of the Department of Environmental and Preventative Medicine at Bart's and is the Professor of Environmental and Preventative Medicine of the University of London at St. Bartholomew's Hospital Medical College.

Professor Lawther was the Marc Daniels Lecturer at the Royal College of Physicians in 1975 and in the same year was the Bisset Hawkins Medalist and the recipient of the Edwin Stevens Gold Medal of the Royal Society of Medicine.

In addition to his other activities, Professor Lawther is the author of very many papers on the effects of air pollution on health; he is well known as a lecturer throughout the world and acts as Consultant Adviser to the Department of Health and Social Security, is Civilian Consultant to the Royal Navy in Environmental Medicine and is the Sir Arthur Thomson visiting Professor at the University of Birmingham.

NATIONAL SOCIETY FOR CLEAN AIR

Annual Public Meeting, Wednesday, 9th July 1975

Address by The President,

Professor, P. J. Lawther, M.B., D.Sc., F.R.C.P.

By making me President of the Society you have conferred on me the greatest honour I have received in my professional career; I am uncomfortably aware that you have invited me to join a line of distinguished predecessors—learned men, men of action, and men of vision—but I assure you that, despite my inadequacies, I will strive to do all in my power to further the work of what I may now call our Society.

I asked Admiral Sharp what was required of me today and we agreed that it might be appropriate to address you under the heading "Air Pollution and the Public Health: A Perspective". I entered this field just 22 years ago and I have been looking back to see how and where the scene has changed, and to try to assess what I have learned and have yet to do. Recently I was set a similar task in being asked to give the Edwin Stevens lecture at the Royal Society of Medicine in which I allowed myself the indulgence of giving a personal appraisal of the topic. In re-reading the Beaver Reports I discerned the development of a paradox and I took this as my theme. I hope you will not object to me quoting from my lecture. I recalled that the Beaver Committee's Report had said "Enough has been said to prove that air pollution as it occurs in this country is a social and economic evil of the first magnitude. It not only does untold harm to human health and happiness; it is also a prodigal waste of material resources. Expenditure in curing it would be a fraction of the savings which would result from the cure. The case for preventive action is overwhelming" and I quoted the opening of the Interim Report of the Committee: "Sufficient is known already about the causes, effects and cure of air pollution to enable the broad problem to be appreciated, measured and largely tackled." I said "So effective was the implementation of the pragmatic and forceful advice given that the first quotation may no longer be applicable to the present scene. Paradoxically, the second statement may yet be true in relation to the problems which remain though obviously there will come many new pollutants whose effects are as yet unknown or merely suspected which merit careful study and the maintenance of constant vigilance. But with the dramatic fall in pollution by the "classic" contaminants, smoke and sulphur dioxide, and the consequent benefits to health, there is an urgent need for careful thought to supplement worthy zeal, because many of the remaining problems are difficult to define and assess and very expensive to solve. The literature is full of accounts of "doing" (activity and concern in the pollution field seems often to be inversely related to its concentration) but it has been said that "there is no expedient to which a man will not resort to avoid the real labour of thinking." Much thought is needed in this post-Beaver era lest we cripple ourselves economically by applying remedies which might be needless, unworkable or unbearably expensive in relation to the other social ills which beset us."

I hope that you are not now thinking, after hearing this long quotation, that I believe that the fight is now over, and that you regret having elected me President! I care passionately about clean air but recognise that there are tough times ahead in which careful sober argument must prevail. I believe that this Society, having been responsible for so much of the victories of the past, must now bear much responsibility in the more difficult future.

Lord Ashby, when he gave in this Hall the second Beaver Memorial lecture—one of the finest talks on air pollution which I have ever heard—set the scene by going back exactly 23 years to the date of his lecture in 1952. Then, on December 3rd, the cattle for the Smithfield show were being assembled just prior to the 1952 London "smog". It is implicit that this Society had been well aware of the evil effects of air pollution since its foundation but many of us less enlightened people were quite unaware of its importance and accepted it as part of urban life.

I looked for, and found, a letter which I wrote to my son, who was six months old at the time, dated 5th December, 1952; some new stamps had been issued on that day and I thought that he might one day want to collect first day covers. I wrote "Here is a letter for you. It is a foggy, foggy day . . .". I posted it at the London Chief Office and doubtless returned, round the corner, to Bart's. I do not remember scenes of carnage in out-patients or in the wards though I know many colleagues who noted distress among patients at other hospitals. But in this observation there lies an important fact: distress and death were seen, overwhelmingly, among those who were already suffering from respiratory or cardiac disease, or who were old and frail. So many of us took the "smog" for granted. But we were soon to catch up with your Society and to recognise that in air pollution we had a serious menace to health.

I was at that time working on the mechanics of the lung and my first task, given to me by Professor Christee, who was Consultant Adviser to the Ministry of Health, was to see if the civilian gas mask (of which there was a considerable surplus!) would afford protection to patients with emphysema who were especially susceptible to pollution. My laboratory notebook contains the record of my first experiments on air pollution: the patient's comments were unprintable but could be interpreted to indicate that he would rather die in the "smog" than in the mask. So began our crude tasks of trying to devise protection against as yet unidentified physiologically active pollutants. "Smog masks" had to be efficient filters but with low resistance to air flow; we were sent sacks full of inventions which we appraised for the Medical Research Council in irreverent and hilarious terms. Much excellent work in mask design and production was done at Porton.

I remember well my early contacts with Dr. Parker, Dr. Craxford and Dr. Wilkins, at the Fuel Research Station at Greenwich and testing various "air-conditioners" for purifying the air in hospital wards. One, which we called Wilkins's folly, was a drum of soda lime through which air was drawn by a Vent-Axia fan; a second, much bigger model had a large filter as well as the soda lime and since it made a noise like a tube train, was labelled Charing Cross. And we tested small electrostatic precipitators devised by the Royal Marsden Hospital, and ammonia bottles to neutralise airborne acid were tested in our wards.

At the same time we started what was to become a very long series of experiments in which we gassed ourselves with various mixtures of suspect pollutants. We started to make measurements of smoke and sulphur dioxide at Bart's in 1953 and in doing research on the chemistry and physics of air pollution we were only carrying on the admirable work done in the 1880's by W. J. Russell, who taught chemistry to Bart's medical students. He was truly a pioneer in air pollution research and did much work on the generation of fogs and on the analysis of pollutants.

Like Lord Ashby, I consulted our archives to find what we were doing on the 9th July 21 years ago. I could find nothing of note. But on the 12th July, 1954, I had gassed my colleague Robert Waller with 10 parts per million sulphur dioxide without being able to detect an effect (so comparatively crude were our methods of measurement) and we had found out on July 7th, by experiment with the cascade impactor backed by membrane filters, that most of the suspended particulate pollution was below one micron in size.

Twenty years ago today it was Saturday, warm and sunny, but it is worth recalling that, though visibility was up to 30 miles, and pollution low, the smoke was $52\mu g$/micro meter whereas today it is about one-quarter of that. We noted with interest that on the 7th July 21 years ago I submitted to the Medical Research Council my ideas and estimates for the establishment of a group (now a Unit) for research on air pollution. They were modest indeed and we were set up in business in December 1955.

We continued gassing ourselves with realistic concentrations of suspect pollutants but still found no consistent pattern which would enable us to point with any certainty to any one pollutant or combination of contaminants as being the cause of the acute effects of air pollution. We supplemented our experimental work with simple epidemiological techniques by which we studied sick people in the community.

In preparing this address I next turned with great trepidation to an account of my first contact with the Society—a paper entitled "The Clinical Significance of Dirty Air"" given at the Southport Conference in October 1956. I recall that Sir Ernest Smith was in the Chair, Sir Hugh Beaver gave the Des Voeux lecture and Enoch Powell gave an excellent account of the new Clean Air Act. But I was happy, and very surprised, in reading my paper yesterday, to find that I do not need to retract anything I said then and indeed, I find that my assessment of the problems confronting us was fair, and my prophecies that abatement might render our work academic reasonably accurate. I finished by saying "The formidable problem of air pollution has one great weakness—we possess the radical solution. We have only to apply it and the whole evil will vanish." We have seen much of the evil lessened.

I talked of our work on motor vehicles. We were then concerned with the allegation, a rather silly allegation, that the diesel engine was the cause of the gruesome epidemic of lung cancer. Happily, we were able to report that we could find no evidence that London Transport buses were creating a hazard, and it is of great interest to recall that our attempts to estimate the concentration of 3:4 benzpyrene in Merton garage in April 1956 were thwarted by pollution by coal smoke. I outlined our future work on the diesel engine (which still continues) but I suggested that the petrol engine might be a far more important hazard to health by virtue of the carbon monoxide it emits. We were already measuring street concentrations and increases in blood levels on exposure. We have been doing so ever since and are intrigued by this pollutant since it poses very difficult problems which seem to epitomise the very real difficulties we must face in recommending legislation and the adoption of criteria or standards. We know that its distribution is very uneven—the concentration falls off rapidly with distance from the source and it can vary greatly with changes in weather—its absorption by man is complex and by far the commonest cause of high blood levels is smoking; I have never been able to acquire 3% saturation of my blood by exposing myself to traffic but levels of up to 10% are commonly found in smokers.

Like so many workers before us we tried to find subtle alterations in function of the central nervous system by exposing ourselves and other volunteers to concentrations giving up to 10% saturation without positive results. But we might have been mistaken in using the intact normal central nervous system as the "test object"; we selected it very properly because of all the tissues in the body the brain is most sensitive to oxygen lack; but it would seem obvious that the most susceptible subjects will be those who by virtue of chest or heart disease are already desperately short of oxygen. There will always be very sick people in the community and they will confront us with the mighty problem of deciding whom we must protect, whatever the cost, against any stress at any time.

Since I spoke at Southport in 1956 I have come to believe that many pollutants which cause annoyance merit urgent study. I used to answer queries about the possible effects of some pollutants, such as grit and dust, as being a nuisance rather than a hazard merely because they did not cause easily manifest somatic disease. But if they cause great annoyance the resultant stress can, of course, cause severe depression and aggravate disease of the cardio-vascular system. Pollutants which cause anger and interfere with out enjoyment in any way are to be deplored.

And the newer pollutants will keep us busy for as long as industry produces more and more complex products. We have the recent examples of crocidolite asbestos and vinyl chloride monomer to remind us that small doses of apparently innocent substances may have dire effects many years after exposure. And there is the incredibly complex and vexed question of the relevance of airborne lead to keep us at full stretch.

And so we come to appraise the present scene in this brief, sketchy, and nostalgic perspective. I hope you will tolerate another quotation from my Stevens lecture in which I return to Beaver: "The problems posed by air pollution are as complex as its physical and chemical nature. I quoted the Beaver Committee talk in my opening remarks; the very success of the implementation of the Clean Air Act has, in my opinion, invalidated the first quotation: I no longer see air pollution in general in most parts of this country as ' a social and economic evil of the first magnitude '; there are many worse evils which beset us. It used to do ' untold harm to happiness and health ' but not its effects are difficult to discern amongst the effects of other stresses. And it is no longer true that ' expenditure to cure it would be a fraction of the savings which would result from its cure '. In dealing with what is left I think the second quotation is still just: ' Sufficient is known already about the causes, effects and cure of air pollution to enable the broad problem to be appreciated, measured, and largely tackled.' But with the obvious exceptions of the newer pollutants, whose action is yet to be defined, I believe that the problems are no longer medical but technical, socio-economic and even ethical. Those who would clean the air further must decide, if their action is to be effective, whom they are going to protect, against what stresses, for what proportion of time, and at what cost. This is a formidable problem and its solution requires the use of reason rather than emotion. In appraising the problem and in advocating reform one must beware of the dangers of causing depression. As a physician, I see much iatrogenic illness caused by the constant references to ' environmental ' catastrophies and prophecies. Our zeal may have greater effects than some of the pollutants we fear."

It is in this context that I see the future role of our Society. There is an urgent need to continue to think very hard.

I finished my lecture by referring to the tragedy that as pollution of the ambient air decreases and its effects become more difficult to discern, the effects of self-inflicted pollution—smoking—intrude in all our work. It contributes to about 100,000 premature deaths in this country each year and we do little about it. I remember being so worried that at the Southport meeting of 1956 of the National Smoke Abatement Society, I could not see the back of the hall for tobacco smoke—today I can see alright and the Society is to be congratulated on the reform and I will urge it to greater efforts!

Earlier I talked of my prophecies and the fulfilment thereof. Will you allow me a final quotation from a beloved prophet. Those who think that concern about air pollution began only after the 1952 "smog" ought to read Arnold Marsh's classic book "Coal Smoke". In his foreword, written in 1947, he said: "The drive against smoke is now fast gathering momentum and one of the difficulties in completing the book had been the extent of the progress that has occurred during the course of writing. Some of the measures advocated in the final chapters are already coming into the field of practical politics, but a great effort is still needed to end the evil. It is the writer's hope that his work may in a small way help forward and accelerate progress towards the truly glittering prize of a smokeless Britain, and his ambition is, that if he should write another volume on the same subject, it will be entirely historic." How I wish he were here today to share my happiness.

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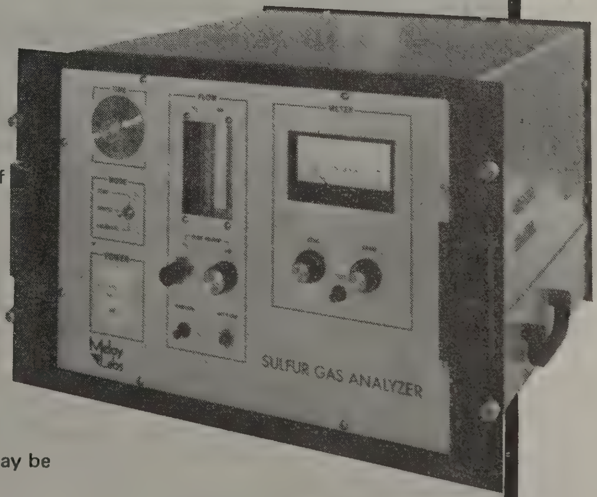

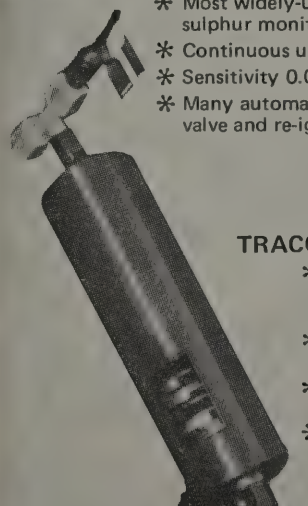

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Some Aspects of Air Pollution on a Global and Continental Scale

by
J. S. Sawyer
Director of Research, Meteorological Office

(Talk given on 30 April 1975 to the N.S.C.A. London and South East and Central Southern Divisions)

Introduction

Public concern about air pollution has a long history and the stimulus for it has come from the concentrations of smoke in the atmosphere of our industrial areas which have been obvious for everyone to see. Naturally, greatest interest centres around the occasions when the meteorological conditions are such that our cities are not adequately ventilated. Then smoke, sulphur dioxide and other industrial effluents accumulate over industrial areas and can reach concentrations which are unpleasant and harmful to health as in the infamous London smog of December 1952. The meteorologist's concern with such events is principally to understand and predict the circumstances in which winds may fall so light as to allow smoke to concentrate at the same time that upward diffusion is also seriously inhibited.

There has been a great improvement in the quality of the air of our cities resulting from the clean air legislation and the reduction in the use of the domestic fire as a means of heating, but other problems of air pollution are beginning to cause concern. The problems of which I wish to talk today differ from those of city smog in several ways. Assessing them requires a full understanding of atmospheric behaviour and it is as a meteorologist that I wish to speak.

Any gas or aerosol which is emitted from our chimneys must go somewhere. It may accumulate in the atmosphere, but it is more likely to come to earth again somewhere else, although it may be chemically transformed before it does so. In considering the problems of concentration of local air pollution in our cities we have in the past, perhaps, tended to ignore any questions concerning the ultimate fate of pollutants once they had been diluted sufficiently by the wind to be of no immediate concern. However, we are frequently being reminded that the "space-ship earth" is a closed system, and that neither the atmosphere nor the earth's surface has an infinite capacity to absorb our effluents. It therefore behoves us to consider the longer-term effects of what we put into the atmosphere. The problems are not those of local, high concentrations of undesirable gases and particles, but rather those arising from long-term accumulations either on the ground or in the atmosphere. The meteorologist is particularly concerned with any effects that such changes in atmospheric composition might have on the world climate.

The idea that growth of man's activity may ultimately destroy the "environment" has caught the public imagination and there have been many "doomsday" predictions based on different effects of atmospheric pollution. It is difficult for the non-specialist to distinguish potentially serious problems from "science fiction" in the views that have been expressed. It is therefore, perhaps, useful to review the meteorological background to some of the ideas which have been put forward.

Long-range transport of pollution

There is nothing new in the idea that air pollution may be observed a long way from its source. The plume of haze extending downstream from industrial areas is clearly recognisable, and visibility over southern England may fall to 5 miles or so when easterly winds bring air from the Ruhr. However, the long range transport of pollution has been the source of increased concern since the Scandinavian authorities have noted an increasing acidity in their rivers and lakes (Royal Ministry of Foreign Affairs, Stockholm, 1971), and have attributed this to air pollution transported from the industrial areas of the United Kingdom and Europe—since the most frequent winds are south-westerly the United Kingdom is particularly suspect as a source. There are other possible causes of the increasing acidity—forestry practice, land drainage and use of fertilizers—but the contribution of airborne pollution deserves examination.

As a result, a co-ordinated plan for studying the airborne transport of pollution across Europe has been developed among the countries of western Europe under the sponsorship of OECD. The aim is both to monitor the pollution at sites away from local major sources of effluents, and also to develop methods of calculating where pollution will go and where it will be deposited. The data is being collected at the Norwegian Institute of Air Pollution which is also developing the numerical methods of calculating pollution dispersal on a European scale. It is hoped that the observations will check the calculations, so that the origin of air pollution in any particular area can be attributed to its source. Such knowledge is essential if any remedial methods are contemplated, or if any steps are called for to prevent pollution levels rising above any particular standard as industrial activity increases.

However, to form a budget of air pollution for Europe is not simple. If we turn to sulphur dioxide as the gas most likely to cause the acidity of rainfall, the main processes which have to be taken into account are illustrated in Figure 1.

Recently a series of flights have been made by research aircraft to sample the sulphur dioxide and the sulphate in the form of aerosol as it leaves the east coast of this country during periods of westerly wind (Smith and Jeffrey 1975). Some flights have also been made over the eastern shores of the North Sea, but these have not yet been fully analysed. The purpose is to compare the export of sulphur dioxide across the coast with the amount which is estimated to be produced. The occasions chosen were meteorologically simple—a fairly steady uniform wind and no general rain. The picture which emerges is one in which about one-third of the sulphur dioxide is absorbed by the vegetation and the ground before the air reaches the coast. This is equivalent to a downward flow of about 0·8 cm sec^{-1} and this is broadly in agreement with experimental measurements at the ground. In addition, about one-sixth of the sulphur dioxide is converted into sulphate and forms small particles (or droplets) which remain airborne. This conversion appears to be most rapid near the sources where the concentration is relatively high.

We know less about the remaining processes illustrated in Figure 1. When rain falls through the air the removal of sulphate and sulphur dioxide is probably fairly complete within an hour or two, but it is difficult to assess whether the rain continues to fall through the same air, or whether new air is drawn in and cleansed. Another aspect of the "rain out" is that rain is both heavier and more frequent where the air impinges on a mountain barrier. The mountains thus receive not only a much larger rainfall than the plains, but also a larger dosage of the pollution which is carried down by the raindrops.

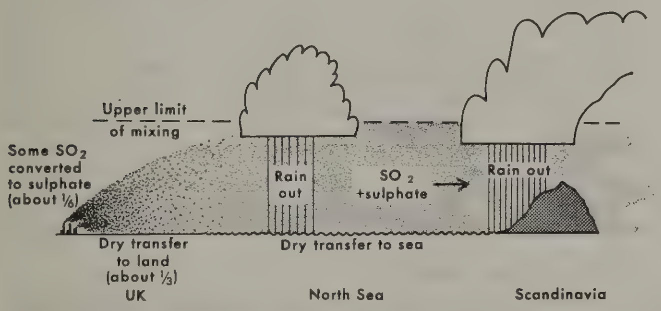

Fig. 1 *The transport and sinks of SO_2*

As the air crosses the North Sea there is a continued loss of sulphur dioxide to the sea surface. The rate is as yet uncertain, but it is probably rather slower than over land because of the smoother surface of the sea. Also some conversion of sulphur dioxide to sulphate continues.

As you will appreciate from this short account of the processes it will be a difficult task to assess the amount of a pollutant which reaches a particular area from a particular source. Detailed studies of all the processes will be required. The current distribution of sulphate brought down by rain can be seen from Figure 2 which is taken from a paper by E. Eriksson (1970). It shows the total deposit of sulphate (as grams of sulphur per square metre) over north-western Europe in 1963 as determined by the Swedish-organised precipitation chemistry network. The distribution is irregular, but shows a falling off to the north and west away from the industrial areas. Eriksson, however, points out the difficulty of attempting to use such measurements to follow any changes in the deposition of pollutants which arise from increase in industrial (or domestic) output or from changes in industrial practice. Figure 3 (also taken from Eriksson's paper) shows, year by year, the deviation of the concentration of sulphur in rain from its average over 14 years. The graphs for Scandinavia and Ireland are followed quite closely by most of the stations in the areas. However, the graphs for Ireland and Scandinavia are quite different, and neither show any steady upward trend which might be looked for as a result of increasing industrial pollution. The explanation is, of course, that the deposition in any area is greatly affected by the weather. Thus any gradual change that might arise from changes in the output of sulphur at its source are masked by the effects of the changes in the climate from year to year. The climatic changes are such that areas as large as Scandinavia are influenced similarly—presumably because more rain with south or south-west winds from UK and Europe brings more pollution to most of the area. However, areas as far away as Ireland respond differently.

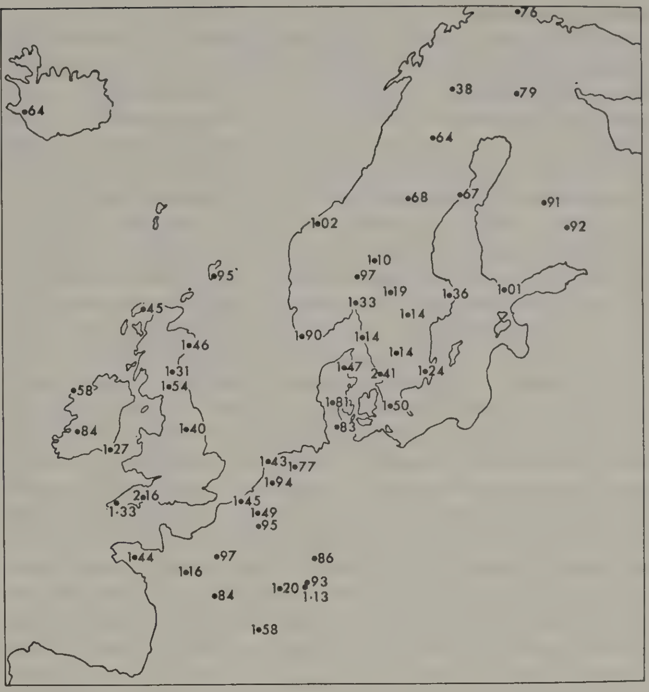

Fig. 2 *Mean concentration of sulphate in precipitation in the W. European area during 1963 expressed as g S/m²*

Figure 3 demonstrates that it will be very difficult to use monitoring alone to demonstrate conclusively that changes in industrial activity or practice have had any effect on the deposition of pollutants, and similarly difficult to demonstrate the results of any action which might be taken to control pollution at its source. The importance of understanding the processes of long-range transport are thereby underlined.

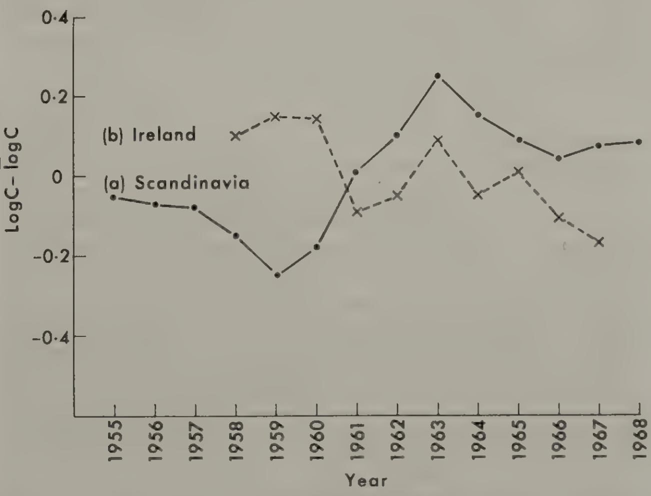

Fig. 3 *Departure of concentration of sulphur in precipitation from long term average (from E. Eriksson, 1970)*

Carbon monoxide

I now wish to turn to another product of combustion which travels even further than sulphur—namely carbon monoxide. Carbon monoxide is, of course, poisonous and it is most undesirable that its concentration in the atmosphere should approach toxic levels. However, some 200 million tons of it are produced annually, and discharged into the atmosphere. Until recently there was little idea where it went to. Unlike sulphur dioxide, carbon monoxide is not readily transformed in the atmosphere, and it is not very soluble in water. In consequence it is not washed out and removed from the atmosphere by rain. This washout process is an important factor in controlling the distribution of pollutants, because under the influence of weather systems, the air in the lowest kilometre into which we discharge most of our pollution is carried upward and mixed with the higher layers of the atmosphere. However, rising air cools, and there is usually enough moisture to lead to condensation and cloud. Thus there is a good chance that, as air moves out of the boundary layer near the ground into the free atmosphere above, it will pass through a region of cloud and probably rain (or snow). The effect is that the air has a good chance of being cleansed of particulates and soluble gases before it reaches the middle and upper troposphere and stratosphere.

Carbon monoxide, however, escapes into the higher atmosphere and observations show that it is fairly well mixed throughout the troposphere. However, Junge (1972) presents observations from an aircraft sampling programme which give a clue to where the carbon monoxide may go. He shows that the concentration of carbon monoxide decreases rapidly above the tropopause. Mixing of the tropospheric air into the stratosphere is a slow process measured in years, but unless there is some process of destruction going on, the mixing ratio would be the same in both troposphere and stratosphere. We conclude therefore that nature provides a sink for carbon monoxide in the stratosphere. Junge suggests that this is provided by reaction with the OH radical which is believed to be present there.

Recent studies of atmospheric carbon monoxide have suggested that there is a natural source of the gas as well as the man-made one. This is probably a biological one in the surface layers of the ocean. There is also a possibility that there is a sink for carbon monoxide in microbiological activity in the soil. These considerations illustrate the complexity of the factors which control the accumulation of pollutants in the world's atmosphere, but we need to understand them better before we can rely on the atmosphere as a safe sink for our noxious products.

Carbon dioxide

I turn now to carbon dioxide which is an unavoidable product of combustion. It is a natural constituent of the atmosphere at a concentration of about 0·03 per cent by volume. One might think that there is no particular cause for concern if by man's industrial activities and domestic fires we add a little to the natural carbon dioxide. However, the matter is not so straightforward. Carbon dioxide plays an important role in the radiant transfer of heat through the atmosphere and into outer space. Changes in the carbon dioxide concentration thus have a potential to change the heat balance of the whole earth, and on this account merit careful consideration.

First we may note that there is direct evidence that the carbon dioxide in the atmosphere is increasing. This comes from observations taken at the summit of a mountain in Hawaii where the air is uninfluenced by local sources of pollution (C. L. Wilson *et alii* 1970). The upward trend amounts to about 0·7 parts per million per year since observations began in 1958.

The annual increase of carbon dioxide in the world's atmosphere is only about half of the amount which is discharged from the world's chimneys, but there can be little doubt that the cause of the increase is human activity. Like carbon monoxide, carbon dioxide escapes from the lower layers of the atmosphere without being removed by clouds or precipitation. The artificial input is well mixed through the whole of the atmosphere. If we are to estimate what the carbon dioxide content of the atmosphere will be in the future, we need to know the sink for the other half of the human input which we do not find remaining in the atmosphere.

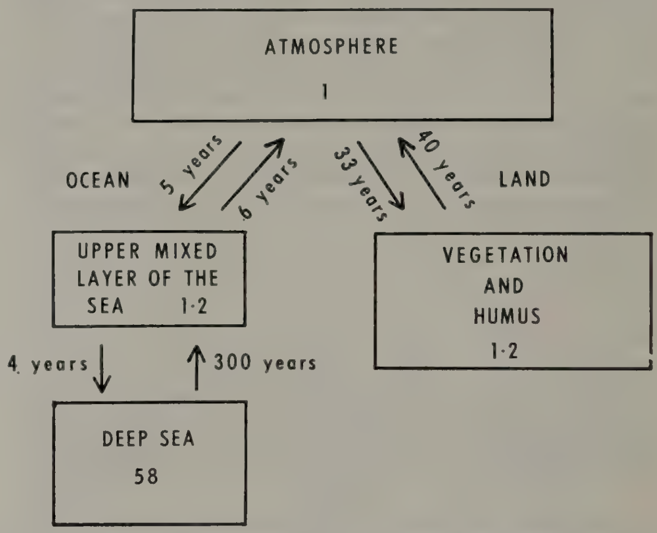

Fig. 4 *Natural reservoirs of CO_2 (based on Craig (1957)). Figure indicated content as multiples of atmospheric content*

Figure 4 displays the natural reservoirs of carbon dioxide (or of the carbon which takes part in the carbon dioxide cycle). The diagram shows the relative capacity of the various reservoirs and the rate of exchange between them. The main potential sink for carbon dioxide is in the deep sea, but the exchange with the atmosphere is a slow process so that equilibrium is reached only over decades—hence the accumulation of extra carbon dioxide in the atmosphere. There is also an important complication in the chemical buffering near the sea surface, as a 0·6% increase in the carbon dioxide content of the sea leads to a 10% increase in the partial pressure in the air above. This has an important effect in reducing the uptake of the extra carbon dioxide by the ocean.

The role that carbon dioxide plays in the heat balance of the earth is illustrated in Figures 5 and 6. Figure 5 shows, in outline, the spectrum of the incoming radiation from the sun and the black-body radiation from the earth. It also shows the percentage absorption by the atmospheric gases. For a range of wavelengths between 7 and 14 μm the atmosphere is almost transparent. In this "window" part of the spectrum, heat is radiated away from the earth's surface directly into space, but at other wavelengths, notably longer than 14 μm, the heat leaving the earth's surface is absorbed by the carbon dioxide in the atmosphere and then re-radiated upwards. The various pathways by which the earth radiates its heat are illustrated in Figure 6. From the point of view of the effect of carbon dioxide on climate the important part of the radiation is that which is radiated from the ground, re-absorbed by the air and then re-radiated to space. In the wavelengths absorbed by carbon dioxide the radiation which ultimately leaves the atmosphere comes from the upper levels above which there is insufficient further carbon dioxide to re-absorb the radiation. The more carbon dioxide there is the higher these levels will be, and, in general, the colder they will be also. Thus if more carbon dioxide is placed in the atmosphere it will radiate (in the CO_2 bands) at a lower effective temperature. The outgoing radiation will be less, and will no longer balance the incoming radiation from the sun. In consequence the earth will warm up until the temperature of the effective radiating levels is raised sufficiently to again achieve a balance. Thus the more carbon dioxide in the atmosphere the higher the equilibrium temperature of the earth.

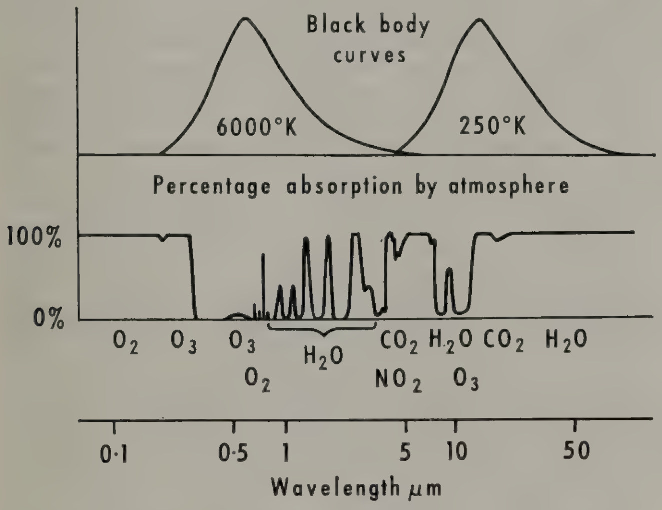

Fig. 5 *Radiation spectrum illustrating absorption by atmospheric gases*

The problem of estimating the equilibrium temperature of the earth is a great deal more complicated than I have described, and the estimation of the effect on world temperature of increasing carbon dioxide is correspondingly difficult. Probably the most reliable calculations that have been performed so far are those of Manabe and Wetherald (1967). They calculate that a doubling of the carbon dioxide in the atmosphere would lead to an increase in world temperature of 2·4°C. Extrapolation of the current trend on the assumption of a continued exponential growth in the use of fuel leads to an expectation of an increase of carbon dioxide of 25% and of temperature of 0·6°C by the year 2000 AD. This is comparable with the natural fluctuations which have been observed in world temperature. A rise of about this magnitude, 0·6°C, took place from the last decades of the 19th century until about 1940. Since then there has been a recession about halfway towards the 19th centry values (Mitchell 1961).

It is worth considering some of the factors which complicate such estimates of the effect of pollutants on world temperature in order that we do not lose sight of the serious uncertainties involved. If world temperature increases so will the evaporation from the oceans. There will be more water vapour in the atmosphere and this will play a very similar role to carbon dioxide—it has absorption bands in adjacent parts of the spectrum. By interfering with the outgoing radiation in a similar way to the carbon dioxide it will increase the effectiveness of the latter in raising world temperature. Manabe and Wetherald take this effect into account by assuming that the average relative humidity of the air remains unchanged. However, there are other possible effects which do not enter their calculations primarily because they are insufficiently understood. Two such effects deserve particular mention. First there is the effect of the polar caps of snow and ice. If world temperature is changed the extent of the average ice caps will also change. An increase in snow cover has an important effect on the reflectivity of the earth's surface; more of the sun's radiation is reflected back to space and is not available to warm the earth or atmosphere, thus adding to the cooling which was originally responsible for the increased snow cover. We have a "positive feed back system". The magnitude of this effect is still a matter of debate. It would probably be more effective in a cooling from the present state than during a warming, because the present permanent ice cover is in a position in which geography tends to control its further recession, whereas expansion over land in the northern hemisphere is possible as in an ice-age.

Another possible "feed back" in the control of world temperature arises from the clouds. These have an important effect on the overall reflectivity of the earth to the sun's radiation, but we do not know how they might respond to an increase in world temperature. Nevertheless a change of 1% in the cloudiness would produce a change in world temperature around 1°C.

Stratospheric pollution and the ozone layer

It would be inappropriate to attempt a survey of possible world-wide effects of atmospheric pollution without some mention of the somewhat alarmist views which have been expressed as to the possible effects of pollution in the stratosphere whether it be from supersonic aircraft, the exhausts of rockets or even from freons diffusing upward after escaping from aerosol cans and refrigerators.

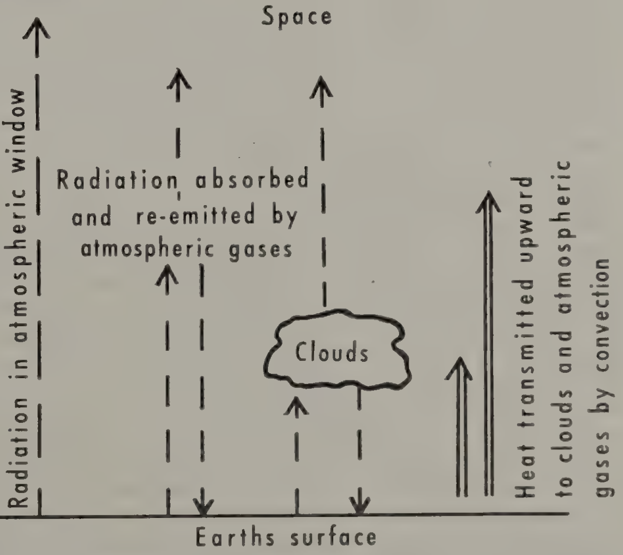
Space
Radiation in atmospheric window
Radiation absorbed and re-emitted by atmospheric gases
Clouds
Heat transmitted upward to clouds and atmospheric gases by convection
Earths surface

Fig. 6 *Pathways of long-wave radiation in the heat balance of the atmosphere*

First, one may ask why there should be this concern about pollution of the stratosphere when a great deal more pollution has been poured into the troposphere. The basic reason is that the exchange of air between the stratosphere and the lower atmosphere is very slow. If material is injected at around the 30km level it may have a residence time there of around 10 years, but at lower levels a kilometre or so above the tropopause, the residence time may be only six months to a year—long enough, nevertheless, to allow accumulation to take place. There is also the aspect that certain constituents of the stratosphere, at very low concentrations, play a significant part in the radiation balance at these levels. Ozone, in particular, is responsible for maintaining the relatively high temperature found in the upper stratosphere and it also filters out from the incoming solar energy a band of ultra-violet radiation which would be very harmful to human and animal life if it reached the ground. The ozone is produced by the action of the ultra-violet radiation on the oxygen, but the chemical processes which control its formation and destruction have recently been found to be much more complicated than was once thought. The equilibrium values which are reached by the ozone concentration depend on various reactions involving several oxides of nitrogen as well as various radicals derived from water vapour. The ozone itself is in concentration of from 1 to 10 ppm depending on altitude. The nitrogen oxides which play the catalytic role in ozone destruction reactions (and hence help to determine the equilibrium value) are in concentrations as low as a few parts per billion. They have only recently been measurable. Understanding of the factors which control the ozone distribution is further complicated by the fact that, although in the upper stratosphere the ozone is in photochemical equilibrium, as one descends to the lower stratosphere the time taken to reach equilibrium extends to a matter of years. Thus the atmospheric motions have the opportunity to transport the ozone from place to place before equilibrium is reached, and the observed distribution is determined as much by air movement as by photochemistry.

During the past three years or so the ozone balance in the stratosphere has been the subject of intensive study both in the USA and on this side of the Atlantic in this country and in France (Murgatroyd 1975). The investigations have brought together scientists with at least four different skills. There have been the laboratory physicists who have endeavoured to measure the reaction rates for some 50 or more chemical reactions between oxygen, hydrogen and nitrogen derivatives which determine the ozone concentration in the stratosphere. There have been also the atmospheric physicists who have undertaken the difficult measurements of the various reactants—particularly the nitrogen oxides—in the stratosphere using aircraft and balloons. The theoretical photochemists have also had an important role in computing the equilibrium levels of the various reactants involved, and finally the meteorologists have endeavoured to assess the effects of the air motions on the equilibrium levels of ozone. The stratospheric air motion cannot be observed in detail on a worldwide scale, and so the meteorologists have had to depend on theoretical calculations of the dynamics and thermodynamics of the stratosphere, checking their results against the observed behaviour where it is known. The calculations involved tax even the largest computers because the only satisfactory way so far discovered for calculating the effect of air motion on the ozone distribution is to calculate the air motions hour by hour and day by day through the seasonal cycle. Only in this way can the effects of transient air motions and weather systems be assessed. Now the meteorologist needs to add calculations of the photochemical processes at every step.

This work is still in progress on both sides of the Atlantic, but as the studies have proceeded the scientists' views have tended to gradually converge in regard to the general level of the effect on the ozone layer which might be expected from the exhaust gases of supersonic aircraft. The current view is broadly reassuring. For up to 100 Concorde type aircraft operating commercially the reduction of total ozone is estimated to be about 1% or less—considerably less than the natural variations. (An unexplained increase of 10% is believed to have occurred in the last decade.) Some confirmation of the calculations comes from the major hydrogen bomb tests in the atmosphere. It is calculated that these placed as large a quantity of nitrogen oxides in the stratosphere as would have been produced by 1000 Concordes in a year. Nevertheless no definite effect on the ozone layer can be detected in the observational series.

Quite recently a new possible threat to the ozone layer has been given prominence. This is said to arise from the freons which are used as refrigerants and in aerosol sprays, and which are released into the atmosphere when they have served their purpose. These compounds of carbon, chlorine and fluorine are very stable in the atmosphere and have been detected in the atmosphere far from their sources in the centres of population. The atmospheric concentrations are, of course, very low—a few parts in 10 thousand million—but these gases appear to be accumulating in the atmosphere. It has been suggested that they will diffuse slowly up to levels of 20 or 30 km where ultra-violet light will cause them to break down. The resulting free chlorine would react with the ozone and is another possible mechanism by which the protective ozone layer might be diminished. (Molina and Rowland 1974). At the present time the effectiveness of these processes has not been fully assessed, and it is also not clear why the freons should be more effective in the destruction of the ozone layer than certain naturally occurring organic chlorine compounds such as carbon tetrachloride (Lovelock 1974). The subject clearly deserves further study, but as with the aircraft pollution problem the risks may not prove to be as serious as implied by the first assessment.

Effects of air pollution on climate

As the scale of human activities on the earth increases there are several possible ways in which these activities might lead to changes in climate. Up to the present time the effects have been insignificant except on a very local scale. However, if industrial and other activities continue to increase exponentially, then within the next century we must anticipate significant climatic effects and mankind must accept them or take steps to avoid them. Not all potential man-made effects on climate arise from air pollution, and, although the main theme of my talk is the consequence of air pollution, I will digress for a short while to mention some more easily assessed effects of man's activities on climate.

It is desirable first to remember that the world's atmosphere constitutes a very large and energetic system compared with which man's activities are comparatively puny. For example the total mass of the atmosphere is almost 1000 times greater than the total coal reserves, so that our fires and furnaces can only make minor changes in atmospheric composition. Also a large depression generates and dissipates kinetic energy at a rate of about 100 W/m^2 compared with which the total power consumption in the United Kingdom is only $1 \cdot 5$ W/m^2. Nevertheless the atmospheric system may have sensitive aspects and the possibility of human effects deserves study.

The simplest possible effect to assess is that of the direct output of heat from our fires and factories. Worldwide this is only a little more than one ten thousandth of the incoming solar radiation, and it is probable that it would have to increase 100-fold (ie to about 1% of the solar radiation) before it had a significant effect on world temperature as a whole. However, human activities are not uniformly spread over the surface of the earth, and one may ask whether the concentration of industry in Europe and the USA might not produce regional heat sources sufficient to upset the atmospheric circulation. Fortunately nature carries out a relevant experiment quite frequently. From year to year the oceans vary in temperature by a degree centigrade or so. The temporarily warm ocean provides a regional heat source which is responsible for at least some of the variations in our climate from year to year. To have a similar effect man's industrial heat output would have to match that of the ocean over a similar area, and this would require an output of about 50 W/m² over an area comparable with the size of western Europe. The present industrial and domestic heat output is about 1 W/m² so that a 50-fold increase would be needed before a climatic effect comparable with natural year to year variations resulted. An annual growth rate of 5·5% (often quoted as typical of current trends) would lead to such an effect in a little over 40 years, but I leave you to judge whether this is likely.

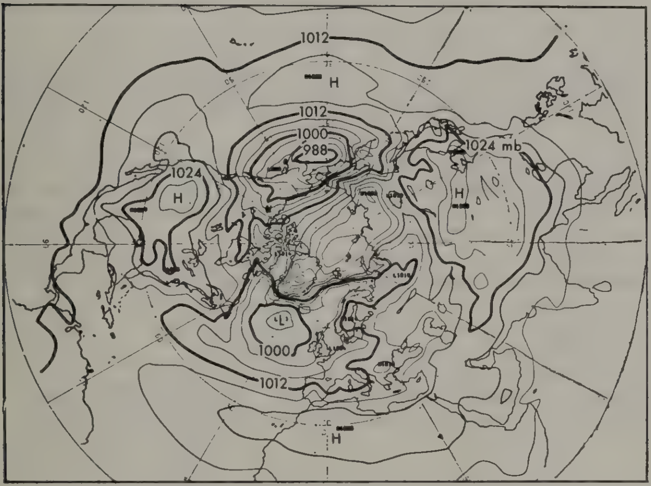

Fig. 7a *Computed January sea-level pressure chart. Average days 41-80. Exp. 90*

Of course, industry is not the only potential means by which man might affect climate. The greatest changes in the face of the earth are produced by agriculture. Changes in the reflectivity to the incoming solar radiation are brought about by agricultural practice and removal of forests, and changes in the evaporation of water from the surface result from irrigation and from the clearing of vegetation prior to cultivation. So far no large-scale effects on climate have been clearly established but it is interesting to note that, if all the water of a major river, such as the Indus, was used in irrigation, an anomaly in the heat budget of the atmosphere would be introduced of a similar magnitude to those which arise from fluctuations in ocean temperature and lead to the year to year variations in climate.

As regards the climatic effects of air pollution, I have already discussed the changes in the radiation and heat budget of the earth resulting from the increase in the carbon dioxide content of the atmosphere. A second possible effect would arise from the increasing load of particles carried by the atmosphere as a result of the smoke output from our chimneys and from other activities. It is estimated that between 5 and 45 per cent of the particles in the world's atmosphere are man-made. Not all of these enter the atmosphere in solid or liquid form—many are produced by chemical transformation of gaseous emissions—sulphates from sulphur dioxides, nitrates from nitrogen oxides etc. The significance of aerosol is that it scatters and absorbs the incoming solar radiation so that less reaches the ground. Various attempts have been made to assess the possible effect on world climate but none of the estimates have a satisfactory basis. Fortunately aerosols do not accumulate in the atmosphere, they are normally washed out by rain within a few days and large areas of the atmosphere over the more remote oceans and land masses remain clean. Also much of the scattered light is not lost—although it reduces the direct radiation from the sun, it enhances the radiation from the rest of the sky. Volvanic eruptions occasionally place a pall of dust in the stratosphere which spreads over much of the world. Even though the direct sunlight can be reduced by as much as 10% the effect on world temperature is barely detectable because of the counter balancing increase in the radiation from the rest of the sky. For these reasons the world cooling which might result from an increased aerosol load in the atmosphere is probably less than is sometimes estimated. However, the matter deserves further study.

Another possible climatic effect of industrially produced aerosol arises from its effect on the microphysics of clouds. By providing additional and, often hygroscopic, nuclei for condensation the industrial effluent may alter the dropsize distribution in cloud and modify the production of precipitation. The extent to which the rainfall in and to the lee of cities may be affected is a matter of controversy. Some of the more extreme effects which have been reported are probably the result of poor observations or short samples, but the distribution of precipitation around St Louis is being thoroughly investigated by a major US field programme. Preliminary results show some variations of the order of 20% in the distribution of rainfall around the city. (Huff and Schickedazz, 1974). Whether this is a result of the aerosol, the heating effect of the city or its mechanical roughness is uncertain. It is also quite uncertain whether any effects could be produced on a wider scale.

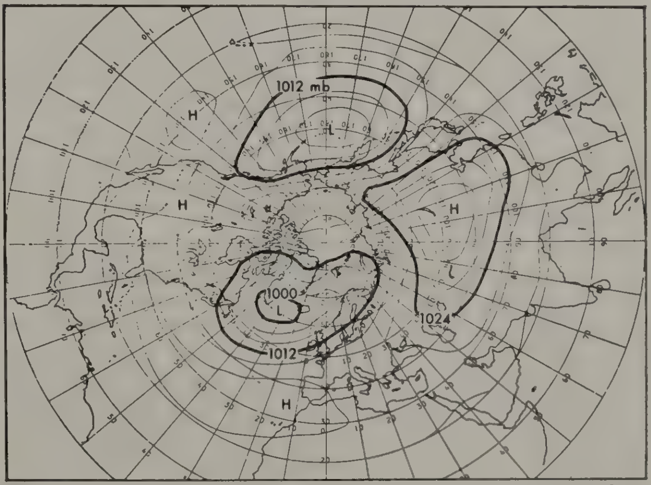

Fig. 7b *Observed January mean sea-level pressure chart 1973-1972*

Problems of assessment and control

It will be apparent from what I have been saying, that up to the present the only clearly detectable effects of atmospheric pollution on weather and climate have been local and close to the source. The reduction of sunshine by smoke has long been known and has been mitigated substantially by the efforts of your Society. The urban "heat island" of a few degrees centigrade is also well known but is on the whole beneficial at least in temperate latitudes.

However, if industrial activity throughout the world continues to increase, we are entering into a phase in which new and more difficult problems will arise which will affect not only the immediate surroundings of the polluting source but a whole region, or, indeed, the whole world. Any efforts to meet such problems, or to control effluents in order to avoid them, will require international negotiations and arrangements. The complications are likely to be great.

It will be necessary to establish a firm scientific basis for the consideration of such problems and this is not easy. So far we can do little more than assess whether or not a problem exists. We can, perhaps, established a threshold below which air pollution is unlikely to have a significant climatic effect, but if we exceed that threshold we are as yet in no position to say how large the effect will be nor even whether it will be beneficial or harmful.

Much research is going on to understand the factors which control the climate. The problem is so complicated that we can only claim to understand the climate if we can calculate the observed climate from the fundamental principles of physics and dynamics. A great deal of progress has recently been made towards this. However the climate is made up of the day to day weather with all its variations, and so far no way has been found to calculate the climate, other than by calculating the weather day by day—the motion of individual storms etc—and then taking the average over a representative period. Such calculations tax even the largest present-day computers. I conclude by illustrating how far such work has progressed by presenting from the work of the research team at Bracknell, the mean sea level pressure map for January as calculated and observed (Figure 7). The general agreement is good but the error in detail is greater than the climatic changes about which I have been talking as a possible consequence of pollution.

Nevertheless the proper assessment of man's effects on climate can only be carried out on the basis of similar numerical simulations of climate into which the physical effects of pollutants etc have been incorporated. Such work will certainly be undertaken and is indeed already under way both in the USA and here. However, I would be misleading you if I were to give the impression that the work will be easy or the results unambiguous.

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Letter to the Editor

Dear Sir,

I am writing on behalf of my fellow authors of the paper "Air Pollution in Europe and the Fuel Shortage" to answer the question Mr. Watkins raised in your Summer issue.

In 1974 petrol consumption in Los Angeles was 12m. tons and in San Francisco 5m. tons. I was unable to obtain a similar figure for London and the commuter belt but doubt whether it is more than about 5m. tons out of a total UK market of just over 16m. tons.

Our purpose in quoting these figures in our paper was mainly to draw attention to the enormous quantity of petrol consumed in the USA and the opportunities it provided for conservation. It is thus encouraging to see that the consumption, in the two US cities in 1974, vast though it was, was about 1m. tons less than in 1973. I fear that consumption will rise again during the next few years because of the compulsory introduction of more stringent atmospheric pollution regulations, which have the effect of increasing petrol consumption.

Los Angeles' smog is unique mainly because of the climatic and topographical conditions the city enjoys, which even in this delightful summer we have not been able to emulate in the UK. Nevertheless, Mr. Watkins is right to draw attention to relative petrol consumption although, of course, the geographical area of Los Angeles is far less than that of the Greater London conurbation. I fully support the views he expresses in his letter and am hopeful that a more rational approach to pollution from motor vehicles will continue to prevail in this country.

Yours faithfully,

G. S. Parkinson,
Shell Mex House,
Strand,
London WC2R 0DX

'ENERGY FOR TOMORROW'S WORLD'

The Combustion Engineering Association is holding a Conference entitled 'Energy for Tomorrow's World' on 25th and 26th November 1975, at The Grand Hotel, Eastbourne.

The Conference will study conventional and unconventional sources of energy and the part they could play in meeting the world's changing energy demands. The aim will be to influence thinking towards improving our potential in an increasingly competitive world.

Papers are planned on the following subjects:

World Energy Resources
European Energy Policy
The Role of Oil and Gas
The Changing Role of Coal
Nuclear Fuels
Tidal, Wind, Wave and Solar Energy
World Energy Modelling and Pricing Structures

Non-members will be welcome and enquiries should be made to the Combustion Engineering Association, Beaufort Chambers, 240b High Street, Slough, Bucks. Tel: Slough 33211.

BOOK REVIEWS

The Law Relating to Noise

C. S. Kerse—Oyez Publishing Ltd.—£3·50—188 Pages.

Although there is undoubtedly a need for a small book on the legal aspects of controlling noise, there is so much new legislation in the process of being introduced that this is a difficult period in which to produce such a volume. At the time of writing there is the additional complication that the operative dates for the various noise control provisions of the Control of Pollution Act 1974, Health and Safety at Work etc. Act 1974, etc., have yet to be announced. To add even more to the problems, there is the inevitable delay between the actual writing and the publication of any book, so that the Author and Publishers are to be congratulated on producing a book, covering such a wide subject, which is as up to date as this particular one.

Mr. Kerse has attempted to produce what is a rare type of book on law, i.e. one which is readable and entertaining but at the same time instructive. Existing and proposed legislation are both fully described and where new provisions are involved and as yet there is no experience to draw on, the Author has not hesitated to express his own opinions. After defining noise and dealing with the various types of nuisances, there are chapters on noise abatement zones, planning and compensation, aircraft and traffic noise, occupational noise and noise in the home. In addition to being well indexed the book contains comprehensive Tables of Cases, Statistics and Statutory Instruments, all clearly set out and easy to use.

This is such a well written and useful book that I regret having to draw attention to an error. The Author states that no Regulations have been made to control noise under Section 76 of the Factories Act 1961. However, the Woodworking Machines Regulations 1974 were made on 23rd May, 1974, and became operative on 24th November, 1974. Regulation 44 is devoted entirely to noise.

Although primarily of interest to the layman, students and those actively engaged in the control of noise will find a great deal of valuable material in this paperback. A book well worth purchasing, full of useful information expressed in a clear and interesting style.

C. R. Cresswell

Air Quality Instrumentation, Volume 2, *edited by J. W. Scales, Associate Director, Analysis Instrumentation Division, Instrument Society of America. pp 326, published by the Instrument Society of America, 400 Stanwix Street, Pittsburgh, Pennsylvania 15222. Price £6·50.*

The book contains a selection of 26 papers presented at the 1972 and 1973 Annual Conferences and various Divisional Symposia of the Society. As the editor says in his foreword, the papers include methods of measurement of individual pollutants, calibration and systems of data acquisition. Some papers describe proposed new methods of measurement while others explain the modification and refinement of existing techniques. One of these papers includes a section on the death rates from emphysema in 12 States in the USA. There are 2 papers on other related topics with one on legal cases and the use of the Ringelmann chart for measurement of smoke emissions and the other on the automatic collection and statistical analysis by computer of the results of regular measurements of pollutants from a number of instruments at various distances from the office containing the computer.

The methods discussed for the measurement of the amounts of various pollutants in samples of air and in discharges from power stations and other sources, in addition to direct chemical analyses, include the use of gas chromatography, photometric systems, infra red absorption and fluorescence, ultraviolet absorption, X ray fluorescence, spectroscopy, relative rates in diffusion of different pollutants through special porous membranes and the relative effects of pollutants on the rates of flow of hydrogen into palladium catalysts. One paper deals with pollutants from motor vehicles and another with pollutants from gas turbines for aircraft, both with dynamometer tests.

In one or more of the collection of papers the pollutants or reactivities considered include particulate matter, hydrogen sulphide, oxides of sulphur, sulphuric acid mist, oxides of nitrogen, ozone, carbon monoxide, hydrocarbons and the following elements of their compounds: arsenic, barium, beryllium, bromine, cadmium, calcium, chlorine, cobalt, copper, fluorine, iron, lead, manganese, mercury, molybdenum, nickel, potassium, strontium, titanium, vanadium, zinc and zirconium. Some of the methods of determination of the concentrations of pollutants involve expensive equipment; they may be suitable for special investigations but not for regular routine measurements of the concentrations of pollutants in the air near ground level over large areas.

The paper on legal cases and the use of the Ringelmann chart for measurement of the density of emitted smoke is of general interest. In some of the cases the plea was made that the method is not accurate enough for legislation. It is dependent on human judgement, which cannot be accurate with the various appearances of the background sky and the different rates of dilution as the smoke enters the air. However, the opinion of experienced or trained observers, in some cases by observations without using the chart, was usually accepted. The author of the paper expresses the opinion that reliance should be placed on the measurements by instruments recording the density of the smoke passing upwards through the chimney. He does not refer to the fact that operators do on occasion either put the recorder out of action or adjust it to give unduly low readings of smoke density. It would be satisfactory if there were means for making it impossible for any unauthorised person to tamper with the instrument and there were periodic calibrations.

A. Parker

Solid Wastes—Origin, collection, processing and disposal

Edited by C. L. Mantell. Published by John Wiley and Sons, New York, 1975. 1127 pages, Appendices, Price £22.

This is a timely and comprehensive book of reference and as such, it needs and deserves a better index. At first glance it seems to have been written particularly for those officers in the U.K. newly involved in large scale waste disposal, but closer examination reveals a much wider concept, which is concerned for the total quality of the environment. By defining "waste" more widely than in the U.S. National Solid Wastes Act 1965 many industrial and commercial processes are described in detail, perhaps too much, but the principle emerges that if wastes are properly collected processed and disposed of a better environment will naturally follow.

Dr. Mantell, a consulting engineer, has assembled expert contributions from 46 of his fellow Americans and enumerated them, with designations and addresses, immediately after the title page. Lists of up-to-date references conveniently follow most sub-sections. In addition, references and useful bibliographies follow the principal chapters. Papers submitted by C.E.G.B. London to the 2nd International Clean Air Conference in Washington 1970 are included, but most references are American.

The book is arranged in 8 Parts as follows, each preceded by a short summary.

I. Origins of Wastes
II. Disposal of Waste
III. Agricultural and Food Processing Waste
IV. Animal Husbandry
V. Particulate Collection
VI. Recycling
VII. Process Industry Wastes
VIII. Mineral and Metallurgical Wastes

Liberal use is made of line-diagrams, tables, graphs and photographs, which illustrate or clarify the text.

American statistics of solid waste are set out in Part 1 where we read "at the present time the most convenient means for disposal of solid waste, garbage and trash, is an open burning dump. However, what may have been acceptable at an earlier time can no longer be tolerated". At the close of the chapter the author writes: "The greatest drawback of composting operations is that the potential market for compost is far less than the potential supply." These sentiments are just as relevant in the U.K. Indeed, apart from variations in spelling and American words and phrases the book might well have been written in London instead of New York· "Sanitary Landfill" replaces "Controlled Tipping" and the collection and disposal of all refuse is accepted as the responsibility of the disposal authority, regardless of quantity of technical difficulty.

"Waste" includes grit and dust collected in cyclones, electrostatic precipitators, scrubbers and fabric filters. There is much detail in the chapter on Particulate Collection which would be more appropriate in a Treatise on Air Pollution and the cost of disposing of the collected dust and grit receives only passing mention. The use of fly-ash for such purposes as lightweight aggregates is considered at length.

The disposal of "suffluent", i.e. effluent from sewage disposal and sludge from filter beds, is described, including incineration and use as a soil conditioner and fertiliser. It is accepted that "suffluent" will never be a threat to the chemical fertiliser business but rather a stimulant to the use of inorganic fertilisers.

The burning of sugar cane trash, cereal straw, stubble, cotton stalks and corn stalks to control insect pests brings U.S. waste disposal into conflict with clean air legislation. Photochemical air pollution has been evaluated and there is increasing legislation and local resistance to such burning even though the hydrocarbons from one ton of agricultural waste are far below those from the same weight of auto exhaust.

In the western U.S.A. large quantities of agricultural waste from orchards, grainfields and rangelands are burned as the most practical means of ridding the land of wastes. In suburban areas prunings, grass clippings and brush are mixed with other trash and disposed of in the local incinerator plant. This is one of the few concessions to quantity or expediency.

Waste from the processing of fruit, vegetables and seafood amounts to about 2 million tons, annually, nearly all disposed of by land-fill, spreading or burning. The latter is a relatively minor method but about 300,000 tons of liquid waste is disposed of by dumping into a stream, lake, bay or ocean without any treatment· Little is said of odour control from these wastes or from fish processing into fish meal and animal food although mention is made of malodorous "stickwater" arising in the digestion of fish wastes. Elsewhere, "masking agents" and "counteractants" are relied upon. All are "fairly expensive" for treating any sizeable amount of wastes. The U.K. Working Party on Odours found them ineffective as well as expensive in any situation. Odour nuisance is mentioned frequently and is cited as one of the problems associated with particulate collection from a lead smelting plant.

Among the statistics quoted in Chapter I reference is made to a national total of 300 incinerators. Of these, over 200 are reported to be without adequate air pollution control devices. The author goes on to say: "In many instances, complete abandonment of these facilities will be necessary because of their inadequate design and capabilities." Few would dissent from this statement if it were made in respect of U.K. incineration plants.

Considering the economic situation on both sides of the Atlantic it is no surprise to find a lengthy chapter entitled "Recycling". It includes the recycling of waste paper and the recovery of paper from Urban waste and non-returnable packages. All of this may be considered predictable, but the recovery of secondary gold makes interesting reading even if unexpected and possibly superfluous.

For those who "look wide" it must be "a buy".

S. Cayton

Reducing Nitrogen Oxide Emissions

Of the many known oxides of nitrogen only two, nitric oxide (NO) and nitrogen dioxide (NO_2) are considered to be air pollutants. The sum of the emissions of NO and NO_2 is commonly called NO_x. Man-made NO_x emissions on a global basis represent only about 10% of total NO_x emissions, but these are heavily concentrated in urban and industrial areas. By far the most important source is burning of fossil fuel.

Mainly NO is emitted with small amounts of NO_2. NO_2 is far more toxic than NO, but in the atmosphere NO and NO_2 are easily interconverted from one into the other. Certain photochemical reactions have an important bearing on smog formation which is considered to be much more important from the point of view of community health than is the presence of NO_x per se at its present level.

In the USA roughly one-half of man-made NO_x is emitted from stationary sources and 40-50% of this original is from power plants burning fossil fuel.

In a "Survey on Nitrogen Oxide Emissions from Stationary Sources and Techniques for Reducing these Emissions", by Stichting CONCAWE*, an understanding is presented of the formation of nitrogen oxides in fuel combustion. The data in this CONCAWE Report (4/75) are mainly derived from USA publications because very little information is available from European sources. Main source of NO formation is the reaction of atmospheric nitrogen (N_2 forming some 78% of the atmosphere) and oxygen in the flame. The report discusses the techniques for reducing NO_x emissions in boilers, such as low excess air firing, staged or secondary combustion, flue gas recirculation and changes of boiler design features. The emissions from refinery process heaters and stationary engines (piston engines and gas turbines) and the potential possibilities to reduce these emissions are briefly summarized.

The report, available free from Stichting CONCAWE, 60 Van Hogenhoucklaan, The Hague, Netherlands, lists 18 tables, 18 illustrations and a bibliography containing 40 titles. Reproduction is permitted with due acknowledgment.

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* The Oil Companies' International Study Group for Conservation of Clean Air and Water in Western Europe.

CONTROLLING NOISE ON CONSTRUCTION AND DEMOLITION SITES—

BSI Code of Practice published

Long term exposure of workers to noise is a serious and increasing industrial hazard, as recent medical studies show. Equally, in the community at large, as living standards rise, people are less willing to tolerate excessive noise in their environment at home or at work.

The British Standards Institution, which has already played a leading role in establishing standard methods of measuring noise from various sources, has now published a code of practice summing up current experience of noise reduction techniques in one of the most common problem areas—construction works. The new code, BS 5228 *Code of practice for noise control on construction and demolition sites* is in response to a radical change in the law covering noise from construction sites. Its form is largely dictated by two recent pieces of government legislation, the Control of Pollution Act 1974 and the Health and Safety at Work, etc. Act 1974.

The Control of Pollution Act embodies the new concept of exerting control over noise from construction sites before work on sites begins. It provides local authorities with powers to specify noise requirements which the person responsible for the works will be required to meet. It also requires the Secretary of State for the Environment to approve a code of practice for the carrying out of work on construction sites. BSI was asked to provide that code and has now done so in BS 5228.

One of the code's main objectives is to give local authorities guidelines on what can or cannot be done to deal with noise from construction sites. It is a manual on which they can base their requirements, adapting it to their particular local needs.

For the construction industry, the code should help to meet the requirements likely to be imposed under the new legislation. By paying proper attention to noise problems from the planning stage onwards, small contractors as well as large ones should be able to meet any reasonable requirements placed on them by local authorities.

Practicality has been the keynote in drafting the code. Full advantage is taken of common existing methods of noise reduction—and this often simply means the proper use and maintenance of equipment by personnel on site. Fulfilling the requirements of the code involves the co-operation of everyone connected with the work—local authorities, developers, architects, planners, designers, contractors, engineers and site workers themselves.

Construction and demolition sites cannot be silent work places. But the problems of noise can be contained as BS 5228 makes clear. Publication of the code should make for a quieter life for all of us.

Contents of the code

The opening section provides a range of essential references to existing legislative requirements, codes of practice, statutory notices and consent procedures. It gives notes on the importance of community relations and training of personnel.

Effects of noise upon personnel on site and the means of protecting them are considered in section two. Excessive noise levels can cause permanent hearing loss, but several ways are described of avoiding this serious hazard. Attention should be paid, for example, to the number of tools used in one place at one time. The remainder of the section is concerned mainly with the use of special protective measures.

Section three deals with noise from a neighbourhood point of view. A means of rating noise is given, together with guidance which will enable local authorities to establish a practicable noise level for each site. Regular checks are recommended, and a method of measurement is suggested for this purpose.

A section on project supervision pays particular attention to the stages of the work which precede actual construction or demolition. Planners, developers, architects and engineers are urged to do what they can to anticipate and avoid noise problems at the initial planning stages. This involves early consultation with the local authority to ascertain the limits likely to be required. At the design stage, all available information should be assessed in order to consider the implications of noise, e.g., siting of haulage roads, preferred off-site vehicle routes, subsoil conditions, and site layout. Considerations to be taken into account at tender stage are listed.

For work on site the code covers four essential aspects: a special works programme including such precautions as the use of soil dumps as noise barriers; specific silencing measures; planning of working hours; and the adoption of quieter types of construction where possible.

Control of noise at source, and control of noise spread are dealt with in the final section. Substitution of plant, modification of equipment, careful siting (and use) as well as maintenance are considered. With noise spread, distance is the most important factor, but increasing the distance between work and the listener may be impossible. Advice is given on estimating noise so that designers can allow for screening at an early stage.

Appendices provide full information upon how to put the code recommendations into practice. They include methods of noise measurement, lists of typical sound power levels from typical items of equipment, and details of the sources of noise in a wide range of machines, together with possible remedies and notes on their known effectiveness.

Copies of BS 5228 are available from BSI Sales Department, 101 Pentonville Road, London N1 9ND. Price £5 including postage.

Cooling Tower Environment—1974

Proceedings of a symposium sponsored by the U.S. Atomic Energy Commission, Division of Biomedical and Environmental Research, and the State of Maryland Power Plant Siting Programme and held at the University of Maryland on 4-6th March, 1974. Published by the U.S. Energy Research and Development Administration. 648 pages. $16·10.

Cooling Tower Environment—1974 portrays the state of the art of the many aspects of cooling tower environment. Many new ideas, accomplishments, and advances in cooling tower research and environmental assessment are evident from several of the presentations, and procedures of studies currently in progress or plans for future investigations are outlined in others. Numerous models of plume rise, diffusion, and drift deposition are proposed and methodologies for selecting optimum cooling systems and measuring plume characteristics are described. The potential for interactions (effects) of drift with the biotic components is identified, and biological effects from drift deposition observed in several studies are described.

Contributions are from researchers actually engaged in cooling tower studies, and attendance was by invitation to persons concerned with environmental aspects of cooling tower operation, to enhance the free exchange of ideas in discussions. Participants, including representatives from four countries, reported on work from industry, universities, state and federal government agencies, and government contractors.

Published as part of the ERDA Symposium Series, this book is available from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161, as CONF 740302.

The Electricity Council Annual Report 1974/75

Sales of electricity during the past year, already at a low level due to the mild winter and industrial recession, began to reflect public awareness of the need for energy conservation. The continuation of restraint on electricity prices and the further heavy increases in the cost of fuel for generation were factors in the loss of £257·6m incurred by the industry in 1974/5. This result reflects the urgent need to return to a position in which electricity prices cover costs. A step in this direction was taken from the 1st of May 1974, with the extension of fuel cost adjustment clauses to quarterly-billed customers. The continuation of this policy, together with tariff increases this year, will help the industry to approach a break-even situation.

The difficulty of forecasting future demands for electricity had been increased by uncertainty about growth in the economy, changes in fuel prices, and the effects of conservation measures. During 1974/5 the power stations consumed 101·5m tonnes of coal equivalent. The fuel bill showed an increase of 70 per cent over the previous year and is expected to rise another 50 per cent this year. Sales of electricity units rose by 3·4 per cent in 74/5.

Of the £21·7m revenue expended on research and engineering development, 4 per cent was spent on environmental aspects. The Electricity Council is giving the highest priority to promoting ways of making better use of energy. Insulation in domestic premises and integrated environmental design in commercial premises have been demonstrated in marketing campaigns. Advice to industrial customers has centred on the efficient use of energy. During the year under review, the CEGB itself saved about £28m in fuel costs through improved system thermal efficiency. Greater interest has been shown generally in district heating and combined heat/power schemes; nineteen possible schemess are being investigated jointly by Area Boards and CEGB regional staffs. Ten further possible schemes for heat supplies to industrial or commercial sites are also under examination and surveys have been made of likely areas to assess their heat needs. Highest priority is being given to the commissioning and early operation of the advanced gas cooled reactors. It is felt within the electricity industry that their biggest contribution to improving the balance of energy supply and consumption in the U.K. lies in its nuclear programme. It is planned to continue work on the initial construction programme of nuclear plant using heavy water reactors, subject to investment approval being given by the Secretary of State for Energy.

British Gas Corporation Annual Report and Accounts 1974/5

By the end of last year, 87 per cent of appliances had been converted to natural gas. Gas sales showed an increase of 12·6 per cent compared with 1973/4, which was almost exactly on the target set in 1965/6 at the beginning of the natural gas era. Gas now supplies some 16 per cent of the British total of primary energy, and a quarter of the heat supplied to final users (excluding transport). In the domestic sector, gas has a market share of 36 per cent. Total gas available in 1974/5 showed an increase of 10·4 per cent over the previous year. Supplies to meet the demands of existing customers will be the first priority when the Frigg field gas becomes available in the second half of 1977. First supplies from the Brent field as expected at the end of 1979. When Frigg and Brent reach full flow rates, their total supplies will be equivalent to half the daily volume of gas now coming from the southern North Sea.

The Financial Results for 1974/5 show that the Board incurred a consolidated loss of £44·2m after providing for depreciation and payment of interest. Sir Arthur Hetherington, Chairman of the Corporation, pointed out that Government restraint on the prices charged to domestic customers had severely affected an industry with undoubted profit potential. It has recently been announced that the Government has approved gas price rises of between 20 and 28 per cent, scaled on the three-tariff system, to be effective after October 1st 1975. It is anitcipated that this will enable the Corporation to break even in the next financial year in spite of rising production costs and the disappointing delay in Frigg field supplies.

The Corporation continues to support the Energy-saving Campaign. A British Gas School of Fuel Management has been set up, and fuel conservation is an important objective of the Corporation's Research and Development programme. The Midland Research Station has been at work on the development of new types of gas-burning equipment. With its partners, the Corporation has continued to explore and develop the U.K. sector of the Continental Shelf. Hydrocarbons Great Britain Ltd., a wholly-owned subsidiary of the Corporation, drilled two exploration wells in the Irish Sea. This was the first time that the Corporation have acted as operators in off-shore work.

National Coal Board Report and Accounts 1974/5

The settlement of industrial disputes at the beginning of the year gave the coal industry the opportunity to restore production and carry out a heavy recruitment campaign which increased the total number of mine workers by more than 6,000. The training of recruits yielded more manpower for productive work only at the end of the year, but a production drive throughout the industry, helped by an unusually mild winter, prevented any coal shortages.

The Coal Board's financial position showed a striking improvement over last year's figures: an operating loss of £112m was replaced by an operating profit of £34m in 1974/5 which was achieved despite a reduction of £61·9m in Government grants and a special contribution of £16m towards 60,000 applications for pneumonoconosis compensation. This profit was sufficient to cover interest and taxation net of extraordinary items. The Board's long-term prospects have been consolidated not only by the higher price of oil, which now replaces coal as a residual fuel, but by the investment programme proposed in 'Plan for Coal'. Reports of the Coal Industry Examination recommended that the Selby coalfield should be exploited as rapidly as possible, subject to normal planning procedures and that the full potential of the existing capacity of the industry should be quickly realised.

The exploration programme during 1974/5 was the largest in the industry's history. The Board have continued to make representations for an energy policy based on reducing our dependence on imports. The U.K. can supply more of its energy requirements from indigeneous sources than any other major nation in W. Europe, and the Coal Industry provides the largest single share. Coal prices were increased substantially last year, which led to fluctuation in demand from the CEGB.

The Board is paying close attention to the Government policy of energy conservation, and has appointed a Headquarter's Energy Manager, with supporting organisations in the coalfields. The industry's energy costs are no higher than other manufacturing industries but developments made to improve safety, health and productivity are energy intensive, and net savings are not expected to be more than 5 per cent in the short term. Renewed attention is being given to the utilisation of methane drained from collieries for safety reasons.

The Coal industry maintains its rehabilitation of mine surfaces and the working and restoration of open-cast sites to the high standards now expected. The development of domestic appliances has continued with special emphasis on units to burn bituminous coal smokelessly and with high efficiency.

Solid Smokeless Fuels Federation Annual Report 1974-1975

1974-75 proved to be a good year for the Solid Smokeless Fuels Industry. The year started with small stocks but the continuous high level of production ensured that, with a very few local exceptions, supplies were available to meet demand. The mild winter did help but the co-operation of all the trade was the main factor. There is no doubt that the prospect of a settled supply position has affected the public's attitude to the Solid Fuel Industry. There was a marked increase in the interest and sales of all types of appliances, no doubt encouraged by the substantial increases in the prices of oil and electricity.

Another approach was made to the Department of the Environment asking that grant should not be given to householders in smoke control areas to replace the approved open fire. Unfortunately the Department did not think that the time was right to change the present conditions of grant. However, the economic climate could change the circumstances and a further approach is being planned.

Correspondence with the Department of the Environment and the Scottish Development Department on the advantages of building flues in new houses has continued. The Federation's contention is that with the present cost yardsticks, Local Authorities may be constrained to installing heating systems with the lowest capital cost, with insufficient regard to running costs. This can give rise to acute difficulties due to a reduction in heating standards, whilst physical deterioration of the building can be caused through condensation. If the cost yardsticks cannot be increased, then ad hoc yardsticks for the building of a flue, which would permit the use of a wider range of heating systems and fuels, could be the answer.

Due to savings made in current expenditure over the last two years, it has been possible to replace one of the Federation's old mobile exhibitions. The new unit, designed for use at agricultural shows or in smoke control areas, can vary in size according to need. During 1975 it is being used in co-operation with the Solid Fuel Advisory Service at agricultural shows in all parts of the country.

Every effort was made to develop contacts with elected representatives and officers from the new Local Authorities, with a view to learning how they planned to progress Clean Air and House Improvement work.

Electrical Association for Women

50th Annual Report 1974, and Report of the Caroline Haslett Memorial Trust.

On November 12th, 1924, in the London home of Sir Charles and Lady Parsons, The 'Womens' Electrical Association' was formed as a result of a paper presented by the Women's Engineering Society. Caroline Haslett, then Secretary of WES, was appointed the first Director. The name of the Association was changed to the present one in the following year.

1974 was the Golden Jubilee Year of the Electrical Association for Women and gave Branches the wonderful opportunity to celebrate 50 years of EAW work. During 1974 'Then and Now' was the theme for many special projects which revealed the great advances in electricity in the home to which the EAW had contributed. Many Branches combined the Golden Jubilee celebrations with enterprises which featured the campaign theme 'Electricity's Contribution towards a Better Environment'. As well as paying special attention to conservation of energy, consideration was given to conservation in relation to town and country amenities.

The Golden Jubilee Year was launched at the very successful Annual Conference in Edinburgh, and throughout the year special exhibitions were mounted and large open meetings were held to extend the area of the EAW's influence.

It was a great pleasure to the EAW that in its Golden Jubilee Year the C.B.E. should have been conferred on its Director, Miss Mary George.

The Caroline Haslett Memorial Trust is one of the few educational charities operating in scientific and technical areas whose awards are reserved for women.

The continued interest of EAW Branches in the work of the Trust is shown by the fact that many of the Branches have increased their annual donations to commemorate the 50th Anniversary of the founding of the EAW.

New additions to the National Society for Clean Air Library

Health and Safety at Work Act—a practical handbook. Dr. W. T. Jones. Graham and Trotman Ltd., 1975.

Health and Safety—The New Law. James Jackson. Commercial Publishing Co., 1975.

Control of Pollution Act 1974. J. F. Garner. Butterworths, 1975.

Air Quality Instrumentation, Vol. 2. J. W. Scales, ed. Instrument Society of America, 1974.

The Law Relating to Noise. C. S. Kerse. Oyez, 1975.

Solid Wastes — Origin, Collection, Processing and Disposal. Edited by C. L. Mantell. John Wiley and Sons, New York, 1975.

Technology and the Environment. Reports from Scientific Counsellors Overseas No. 8. Department of Industry, 1975.

Environment Contaminants Inventory Study No. 2. The production, use and distribution of Cadmium in Canada. D. B. Lymburner. Environment Canada, Report Series No. 39.

Surface Water Data. Reference Index, 1974. Environment Canada, Inland Waters Directorate.

Public Perceptions of Water Quality and their effect on Water-Based Recreation. J. G. M. Parkes. Environment Canada, Social Science Series, No. 8.

Subsurface Disposal of Wastes in Canada—III. Regional Evaluation of Potential for Underground Disposal of Industrial Liquid Wastes. R. O. van Everdingen. Environment Canada, Technical Bulletin No. 82.

Reports produced by the Secretariat or Working Group Members of Stichting Concawe. Stichting Concawe, The Hague, Report No. 1/75.

Incineration of Refinery Wastes. Stichting Concawe, Report No. 2/75.

Survey on Nitrogen Oxide Emissions from Stationary Sources and Techniques for Reducing these Emissions. Stichting Concawe, Report No. 4/75.

Methods for the Determination of Nitrogen Oxides in Atmosphere. Stichting Concawe, Report No. 5/75.

Existing Environmental Regulations of Concern to the Oil Industry in Western Europe. Stichting Concawe, Report No. 6/75.

The Response of Local Government to the U.K. Clean Air Act, 1956: A case study in the adoption of permissive environmental legislation. Dr. L. T. Foster. Ph.D. Thesis.

Papers presented at the Institute of Solid Wastes Management 77th Annual Conference, 1975.

Papers presented at the London Chemical Engineering Congress 1975.

Papers presented at the 67th Annual A.P.C.A. Meeting; Denver, Colorado, 1974.

Solid Smokeless Fuels Federation. Annual Report, 1974/75.

The Electrical Association for Women. 50th Annual Report, 1974/75.

National Coal Board, Reports, Accounts and Statistical Tables. 1974/75.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Summer 1975)** *which gave the position up to* **31 March 1975.** *They now show changes and additions up to* **30 June 1975.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

As from 23 September 1974, the distinction between "black" and "white" areas has been discontinued. Because of this, the table showing the smoke control position in regions of England has been temporarily discontinued.

ENGLAND
NEW SMOKE CONTROL ORDERS IN OPERATION

Northern
Workington (Harrington No. 3).

North West
Lees Nos. 2 and 3 (North Ward) and No. 4 (South Ward); Manchester C.B. (Princess Road); Wallasey C.B. (No. 18).

South East
Southampton (No. 15 West Quay).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern
Derwentside (Stanley No. 4); Langbaurgh (No. 1 Redcar Central); Middlesborough No. 18 (Ayresome Street/Devonshire Road), No. 19 (Town Centre), and No. 20 (Whinney Banks).

North West
Bolton M.B. No. 3 (Bolton Borough No. 49); Liverpool (No. 27); Rochdale No. 2 (Oldham Road/Middleton); St. Helens (Ashton No. 2); Tameside No. 8 (Audenshaw); Wigan B.C. No. 13).

Yorkshire and Humberside
Craven No. 1 (Glusburn—Part); Leeds M.D. No. 3 (Morley West) and No. 4 (Carlton/Lofthouse/Thorpe).

West Midlands
Dudley M.B. No. 133 (Cradley); Lichfield (No. 1); Nuneaton B.C. No. 14 (Bedworth Heath/Exhall West).

East Midlands
Blaby D.C. No. 9 (Braunstone/Leicester Forest East); Borough of High Peak (Buxton No. 2); Derby B.C. No. 30 (Osmaston); Mansfield D.C. (No. 2).

London Boroughs
Barking (No. 13).

South East
City of Oxford (No. 16); Thurrock (No. 12).

South West
Exeter (St. James No. 1).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern
Hartlepool (Nos. 28 and 29); South Shields (No. 21); Stockton-on-Tees No. 5 (Albany Estate/Norton).

North West
Hyndburn (Nos. 34 and 35); Preston (Nos. 30-33); Stockport (North Reddish/Heaton Chapel); Tameside No. 8 (Audenshaw) and Nos. 17-19 (Stalybridge); West Lancashire D.C. (No. 1).

Yorkshire and Humberside
Calderdale (Halifax 20C Lee Bank/Pellon Lane); City of Leeds M.D. No. 1 (Methley) and No. 2 (Morley—Central); Harrogate No. 6 (New Park); Kingston-upon-Hull No. 14 (Newland West); Rotherham No. 4 (Grassborough), No. 6 (Rawmarsh) and No. 17 (Swinton); York (No. 5).

West Midlands
Newcastle-under-Lyne (No. 9A); Walsall No. 23 (Inner Broadway).

East Midlands
Gedling (Nos. 2 and 3); Leicester (Nos. 36-38); South Kesteven D.C. No. 1 (Grantham No. 23).

London Boroughs
Barking (No. 13); Enfield (No. 20); Waltham Forest (No. 25).

South East
Borough of Gillingham (No. 7); City of Oxford (No. 16); Southampton No. 16 (Portswood and St. Denys); Spelthorne (No. 13).

East Anglia
City of Peterborough (No. 3).

NORTHERN IRELAND
NEW SMOKE CONTROL ORDER CONFIRMED BUT NOT YET IN OPERATION

Belfast C.C. No. 11 (Var).

SCOTLAND
NEW SMOKE CONTROL ORDERS IN OPERATION

Burntisland (Castle); Paisley (Northend No. 18).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Dumfries (Castledykes)*; Dundee (Broughty East)*.

WALES
NEW SMOKE CONTROL ORDER CONFIRMED BUT NOT YET IN OPERATION

Wrexham Maelor B.C. (No. 1).

SMOKE CONTROL ORDER WITHDRAWN

London Boroughs
Wandsworth (No. 7).

SMOKE CONTROL AREAS

Progress Report
Position at 30th June 1975

(Figures supplied by the Department of the Environment, The Welsh Office, The Northern Ireland Ministry of Development and the Scottish Development Department).
** Corrected to comply with Scottish Development Department figures*

	England			*Wales*			*Scotland*			*Northern Ireland*		
Smoke Control Orders Confirmed prior to 31.3.75	4,499			19			246*			63		
Acres		1,439,641			2,855			131,872*			15,583	
Premises			6,469,033			10,499			564,078*			42,081
Smoke Control Orders Confirmed (31.3.75-30.6.75)	41			1			—			1		
Acres		21,980			13			—			—	
Premises			70,244			—			—			130
Totals	**4,540**	**1,461,621**	**6,539,277**	**20**	**2,868**	**10,499**	**246**	**131,872**	**564,078**	**64**	**15,583**	**42,211**
Smoke Control Orders Submitted (31.3.75-30.6.75)	25			2			2			—		
Acres		12,001			25			2,048			—	
Premises			37,292			81			4,557			—
Grand Totals	**4,565**	**1,473,622**	**6,576,569**	**22**	**2,893**	**10,580**	**248**	**133,920**	**568,635**	**64**	**15,583**	**42,211**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

SMOKE CONTROL PROGRESS

Paragraph 39 of the Rate Fund Expenditure Circular (DoE No. 171/74) reads: 'The Government accepts that for the year ahead local authorities may not be able to undertake any more development in the field of smoke control'. Concern has been felt that this has caused some local authorities to extend the completion date of their Smoke Control programmes and virtually cease operation for the time being. Certain authorities have stated that the economic climate has compelled them to do this; other authorities have not been so specific. From an examination of returns made by local authorities for publication in the new NSCA Year Book, it appears that the authorities listed below have extended the dates of completion of their smoke control programmes.

London Boroughs
Barking; Barnet; Bexley; Bromley; Croydon; Enfield; Havering; Sutton; Wandsworth**; Southwark.

England
Aylesbury Vale D.C.; Blackburn B.C.; Bolton (M); Bracknell D.C.; Bristol City; Broxbourne B.C.; Bury (M); Chesterfield B.C.; Dudley (M); Durham City; Kingston upon Hull City; Kirklees (M); Lancaster City; N.E. Derbyshire D.C.; Oadby and Wigston B.C.; Pendle D.C.; Reading (B); Rushcliffe B.C.; South Ribble B.C.; St. Helens B.C.; Wakefield (M); Wigan (M); Windsor and Maidenhead (Royal Burgh); York City.

Scotland
Dumbarton (Royal Burgh); Dunfermline (Royal Burgh); Dumfries (Royal Burgh)*.

N. Ireland
Ballymena B.C.

* Under review.
** Order withdrawn.

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Rolls-Royce—
the RB.211 and the Community

by

H. M. Clayton
Derby Engine Division
Rolls-Royce (1971) Ltd.

This paper was presented to a meeting of the East Midlands Division held on 27th March 1975

Though the views expressed in this paper are of necessity based on Rolls-Royce experience, the basic philosophies are, I think, those of most major industries. I believe I am right in saying that we have progressed from the environmental dark ages of the period starting with the industrial revolution and continuing through to the late 1940s or early 1950s, when pollutions of all kinds were rife throughout the land. The air we breathed, the water we drank and in some cases the food we ate were contaminated by industrial processes and waste. Most industrial concerns of any size, privately and publicly owned, now recognise that their responsibilities are not just to their shareholders. At the same time, the public at large are becoming more aware every day of the needs for improvements in the environment and are much more articulate and even more vehement in their demands. The results can clearly be seen in our steadily improving atmosphere and cleaner rivers and in the various legislation passing through parliament.

The restraints placed on industry to achieve these improvements frequently pose great problems and the aims are often only achieved after much heart searching. These restraints almost invariably increase operating costs and therefore the cost of the finished product. One of the major problems facing industry today is how to cope with these factors, together with others such as rising wages and material cost and still remain viable.

However, we at Rolls-Royce, in common with other major industries, believe we have the following responsibilities and these are listed in a convenient not priority order.

a **To our Shareholders**
In this case the British Government and yourselves, the British people.

b **Our Customers**
We must supply them with a reliable product at a competitive price, and let us have no illusions about this point. We are not like the coal mines or the services industries, e.g. gas, electricity, with captive customers. We live in a hard competitive, almost cut throat world, where every penny or cent on the cost of our product tells against our sales efforts.

c **To our Employees**
We wish to give them the opportunity to earn a living for themselves and their families in the best possible working environment.

d **To the Local Community**
We must operate with the least possible disruption of normal life.

e **The Public at Large**
By this we mean in our case the people round airports from which our engine operate and in the countries over which they fly.

The last two are the problems with which this paper deals.

Dealing first with our responsibility to the public at large.

Improvements can only be made in this area by modification to the engines themselves. We have for a number of years realised the problems associated with the gas turbine, or as it is more popularly known the jet engine.

These are:
1. Noise
2. Atmospheric Emissions (recognised by smoke and smell)

We consider them both factors of air pollution. They are not peculiar to the gas turbine, in fact they are almost identical to those of the car industry, but of course they are made more apparent to the general public, due to sheer unit size (aero engine vs car engine), and the mode of operation. One notices even a single aircraft taking off and flying overhead when the real problems, the sheer volume of traffic on the roads surrounding the airports can go unnoticed.

The problem of noise is a relatively new one, and it is one of the strange facts of modern life that the general public will willingly pay for the pleasure of being deafened in a discotheque, full of cigarette smoke and with noise levels far in excess of those required to produce hearing damage. The same public will write to the local Council or newspaper about the noise of industry, of passinge traffic or aeroplanes taking off etc.

The obvious place to attack the noise of a gas turbine is within the engine itself and over the last 20 years, incidentally long before strict regulations applied, Rolls-Royce had been working on silencing problems.

Figure 1, a plot of relative noise levels vs engine bypass ratio illustrates clearly the improvements that have taken place over the last few years. Using as a basis for comparison the Avon pure jet engine which was used in the first generation jet aircraft, e.g. Comet and Caravelle and remembering that on the vertical scale a 10 PNdB reduction means a 50 per cent reduction in perceived noise, it is clear that the Conway engine is 50 per cent quieter than the Avon, the Spey is a 25 per cent improvement on the Conway.

These changes were affected not so much by sophistidated silencing techniques, but more by improvements in engineering technology.

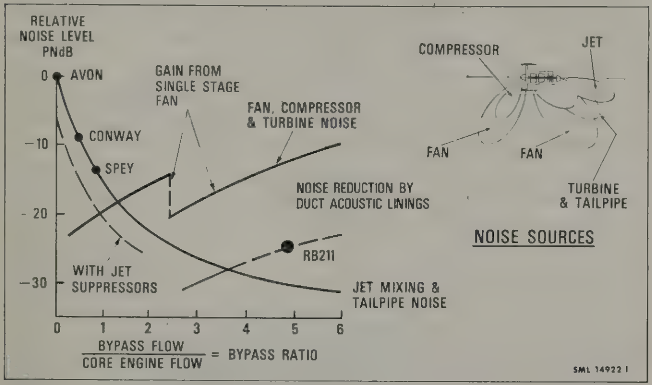

Fig. 1 *Variation of critical noise sources with bypass ratio*

The Avon is a pure jet engine in which all the air taken into the intake is passed through the combustion chambers and exhausted at high velocity and relatively high temperature through the tail pipe, and this was the main noise source. Where as all the newer engines are bypass types (see Figure 2), that is, only a portion of the available air passes through the combustion chamber the rest is bypassed through a ducting (arrowed) which surrounds the core engine. The colder bypass air is mixed with the hot tail pipe air and exhausted to atmosphere at a much lower velocity and is therefore much quieter.

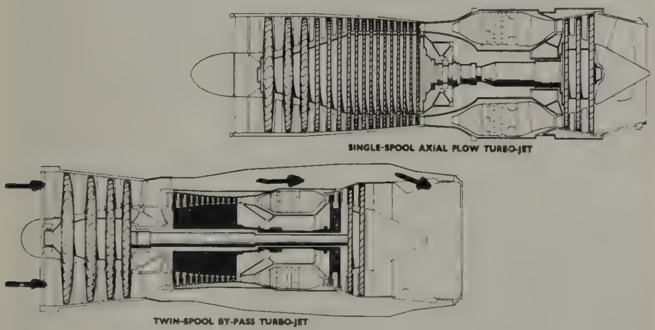
SINGLE-SPOOL AXIAL FLOW TURBO-JET
TWIN-SPOOL BY-PASS TURBO-JET

Fig. 2 *Section view of pure jet and bypass type engines*

However, in silencing the main jet we reach a point on the chart where the machinery noises, fan, compressors, turbines etc, become dominant. With the increase in bypass ratio to RB.211 size which can be seen is 5/1, unless substantial silencing had been carried out the engines would have been no better at a power than the older Spey. Whereas you can see that there is actually a 50 per cent reduction of noise between the Spey and the RB.211. On this engine comprehensive noise source investigations were carried out and the sketch in the right-hand corner of Figure 1 illustrates the source of noise. Silencing, using specially developed sound absorbent material and advanced engineering techniques have been applied and this is illustrated on Figure 3. This shows an RB.211 as most people would recognise it installed in Trans-World Airlines Tri-Star, and Figure 4 shows a section through the same engine. The engine was designed from the start for minimum noise generation with an intake design which requires neither Inlet Guide Vanes or support struts. Extensive studies and tests were carried out to determine the optimum spacing between the fan and its outlet guide vanes and the ratio of number of blades to vanes. The interservice pylon which carries fuel lines, control lines etc, has been positioned to produce the lowest possible interference to the airflow in the bypass ducting and consequent noise generation.

In the compressors special care has been taken in the spacing of rotors and stators. Turbine blade speeds have been kept relatively low and the spacing between turbine rotor blades and nozzle guide vanes has been made larger than had previously been practical. A further major improvement has come from the use of sound absorbent (acoustic) linings and it can be seen that these are used on all the cold stream surfaces in the bypass duct and round the compressors and also in the hot gas stream after the turbines. As the noises which are most critical to the human ear in the mid-high frequency ranges, that is fan and turbine noises, it is to these frequencies that the absorbent linings are tuned.

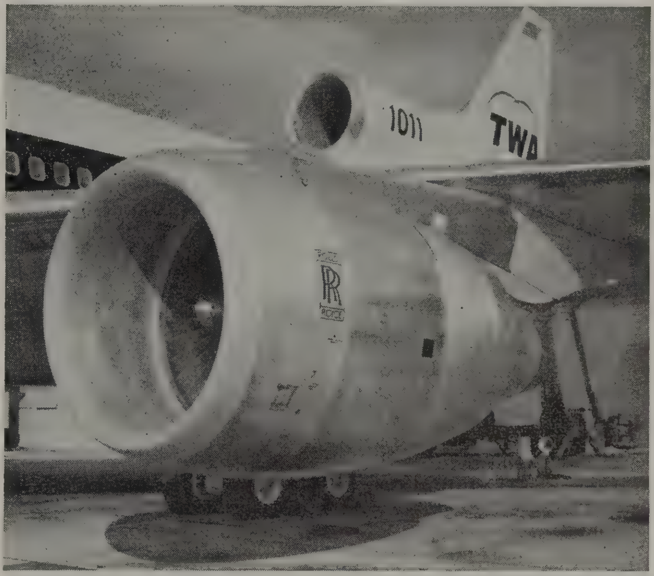

Fig. 3 *RB.211 in Trans-World Airline Tri-Star*

These design improvements have not been made without substantial cost to Rolls-Royce and in a certain measure to the operators. Many thousands of hours of development testing have had to be carried out to arrive at the present point. To give you some idea of the final penalty to the operator of the RB.211 and similar engine. The silencing material in each engine covers approximately 230 sq. ft. and weighs approximately 330 lb. i.e. 990 lb per aircraft. That is equivalent to five paying passengers and their luggage on every flight.

The effect of this work can be clearly seen on Figure 5. This shows the footprint of noise for other current lower bypass ratio long range jets compared with the Tri-Star with RB.211 engines, all using the standard noise abatement take off procedure. The shrinkage of the footprint area from between 50-100 to 8 square miles is, I think, remarkable. It means that people living on the edge of the pattern would have to move two to three times more passengers than these other jets.

Moving on to the other forms of pollution, smoke and smell etc., one has to remember that unlike the noise reduction programme where engine integrity is not seriously involved, the combustion chamber where smoke and smell are produced is an exotic, heavily stressed piece of equipment running at high temperatures and pressures and though the engineers are striving to remove pollutants from the exhaust their first priority must always be the safety of the aircraft and its passengers and crew. The regulations we are working to on pollutants are those of the American Environmental Protection Agency, the E.P.A. Even before the advent of the E.P.A. we, along with other major manufacturers, had adopted what our American friends would call the good neighbour approach in the design and development of our civil engines.

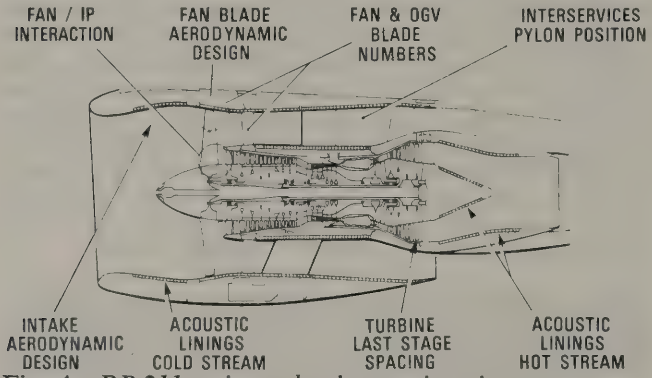
FAN / IP INTERACTION
FAN BLADE AERODYNAMIC DESIGN
FAN & OGV BLADE NUMBERS
INTERSERVICES PYLON POSITION
INTAKE AERODYNAMIC DESIGN
ACOUSTIC LININGS COLD STREAM
TURBINE LAST STAGE SPACING
ACOUSTIC LININGS HOT STREAM

Fig. 4 *RB.211 noise reduction engineering*

On early low pressure engines like the Avon, smoke was not a problem and it did not become one till about 1960, when the advent of our Spey and similar American engines operating at higher pressures gave rise to criticisms about visible smoke plumes from areas adjacent to airports. The exhaust smoke plume on our newer engines has now been reduced to the point of invisibility. The problem was associated with a rich Fuel/Air ratio and got steadily worse as pressure ratios increased. It has been overcome by improvements to the combustion chamber and fuel burner design and by eliminating as far as possible fuel rich areas. Figure 6 shows the RB.211 annular combustion chamber liner. This is approximately 16 inches long and has an annulus with an outside diameter of 34½ inches and an inside diameter of 23½ inches and within this annulus heat is produced at a rate of 75,000 B.T.U.s sec that is 270 million B.T.U.s per hour. Enough heat to run over five thousand (5,000) average domestic central heating boilers or enough power to light a small town.

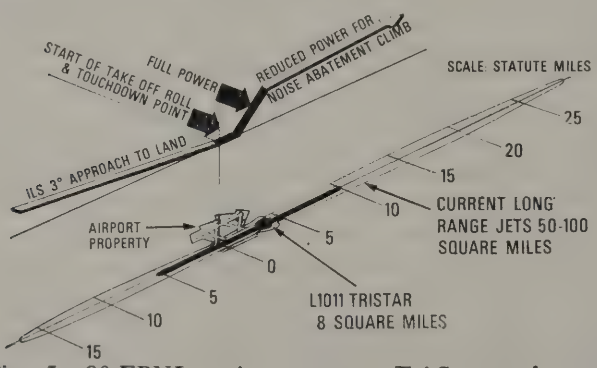
START OF TAKE OFF ROLL & TOUCHDOWN POINT
FULL POWER
REDUCED POWER FOR NOISE ABATEMENT CLIMB
SCALE: STATUTE MILES
ILS 3° APPROACH TO LAND
25
20
15
10
CURRENT LONG RANGE JETS 50-100 SQUARE MILES
AIRPORT PROPERTY
5
0
5
10
15
L1011 TRISTAR 8 SQUARE MILES

Fig. 5 *90 EPNL noise contour—Tri-Star and current aircraft*

The problems are best illustrated by reference to Figure 7 which shows the zone functions of the combustion chamber. Very large quantities of free carbon were produced, within the primary (smoke production) zone. Virtually all of this was then consumed in the combustion zone leaving only a small residue to produce the visible plume and smell. Increasing the consumption of this free carbon was much more difficult than reducing its production. The first step was to reduce the average Fuel/Air ratio mixture within the primary reversal zone, thereby reducing the peak mixture strength as well. (Rather like running a car on a weaker mixture.) This in itself produced troubles in lighting up the combustion chamber, which as any motorist will know requires a rich mixture (choke) for cold starting. This problem was overcome by modification to the combustion chamber and the development of a different type of burner (fuel injectors). The combustion liner modification which included repositioning and re-sizing of various holes in the primary and secondary zone increased the strength of the primary zone reversal and with the burner modification enabled a much more uniform distribution to be achieved. However, this produced a greater heat release within the primary zone which increased metal temperatures locally and generated mechanical strength problems which had to be overcome.

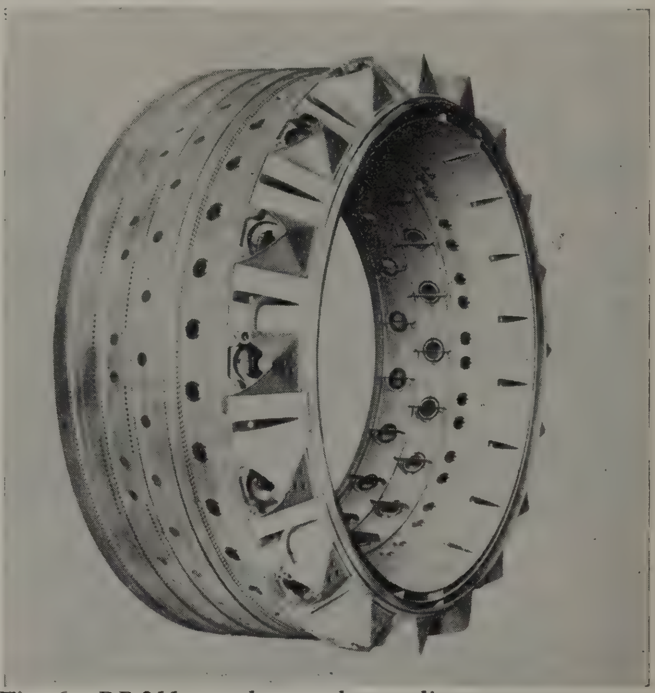

Fig. 6 *RB.211 annular combustor liner*

The fuel injector now used is an airspray type (Figure 8) in which fuel is injected with air at right angles to a high velocity air stream through central annulus into a conical entry to the chamber. The fuel is atomised by the air stream and vaporised as it enters the combustion chamber.

This burner has shown itself capable of meeting all RB.211 operating conditions and with the modifications to the combustion chambers have produced a significant improvement in the flame pattern as shown on Figure 9, which is a plot of contours of fuel air ratio (proportion of mean) at the primary zone exit.

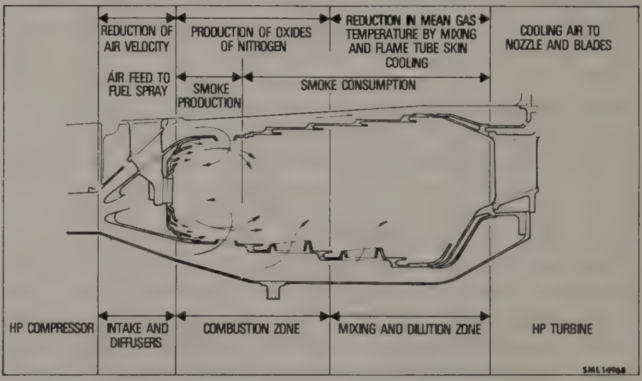
REDUCTION OF AIR VELOCITY
PRODUCTION OF OXIDES OF NITROGEN
REDUCTION IN MEAN GAS TEMPERATURE BY MIXING AND FLAME TUBE SKIN COOLING
COOLING AIR TO NOZZLE AND BLADES
AIR FEED TO FUEL SPRAY
SMOKE PRODUCTION
SMOKE CONSUMPTION
HP COMPRESSOR
INTAKE AND DIFFUSERS
COMBUSTION ZONE
MIXING AND DILUTION ZONE
HP TURBINE
SML 14964

Fig. 7 *RB.211 combustor zone functions*

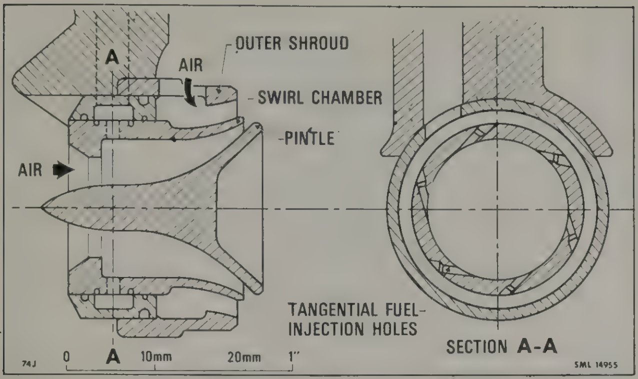

Fig. 8 *RB.211 air spray fuel injector*

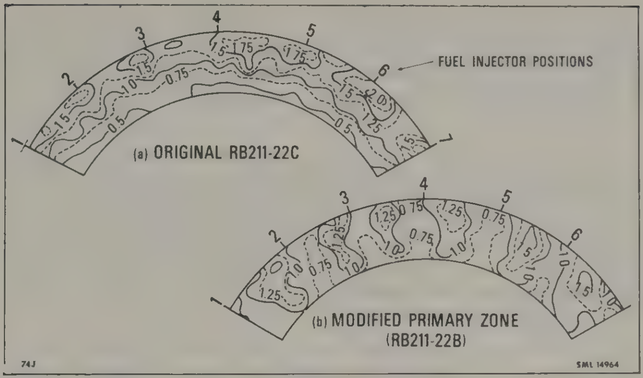

Fig. 9 *Contours of fuel-air ratio (proportion of mean) at primary zone exit*

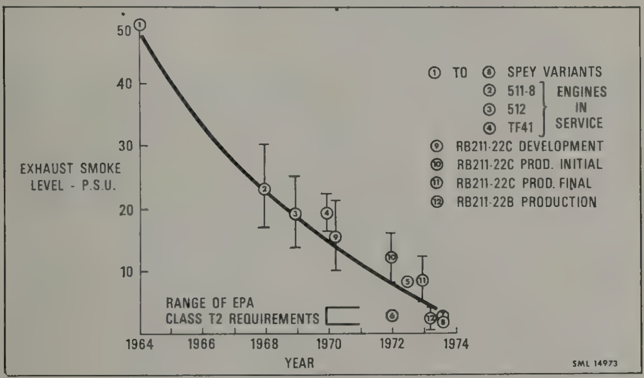

Fig. 10 *Reduction of exhaust smoke in Rolls-Royce high pressure engines*

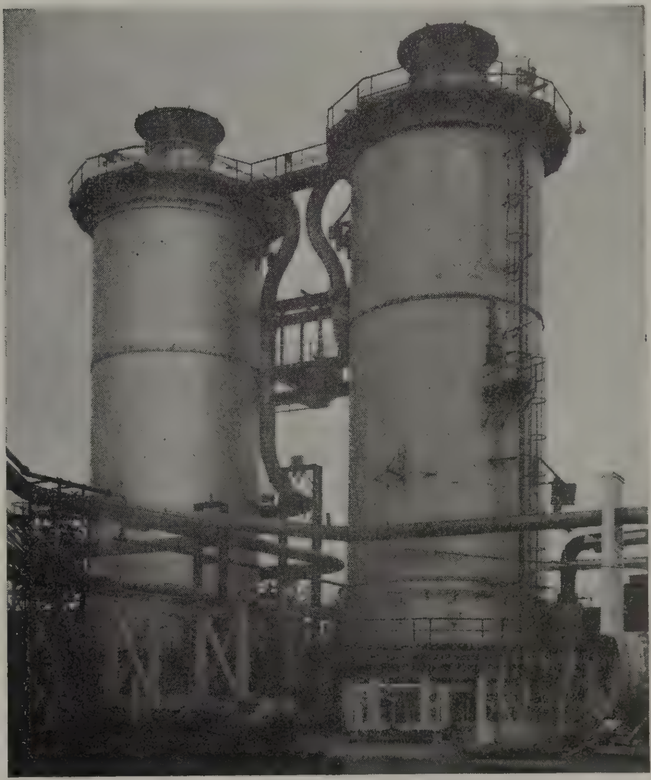

Fig. 11 *Combustion pre-heaters*

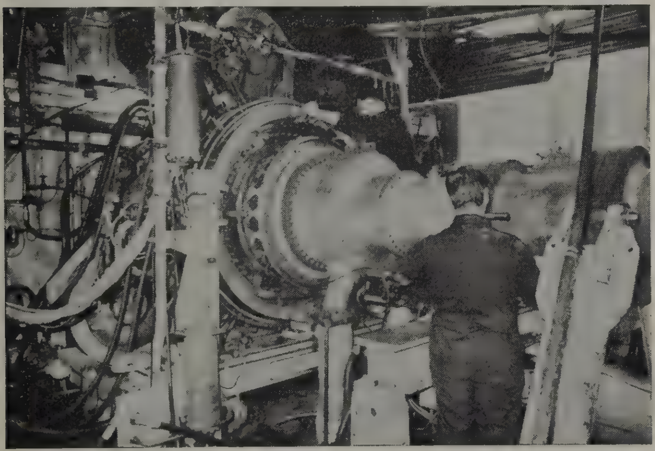

Fig. 12 *RB.211 combustor unit and traverse gear installed on test rig*

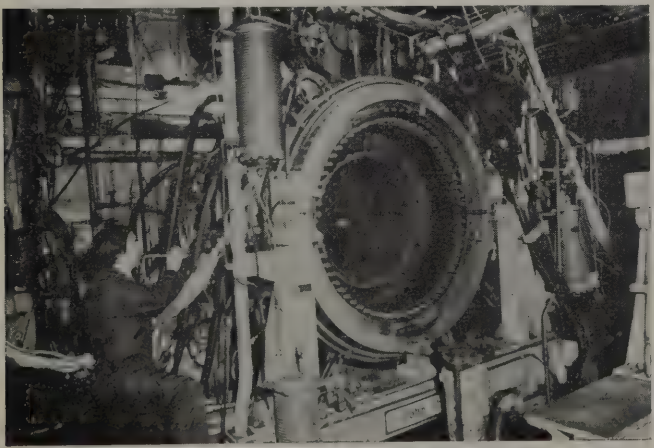

Fig. 13 *Combustion chamber traverse gear*

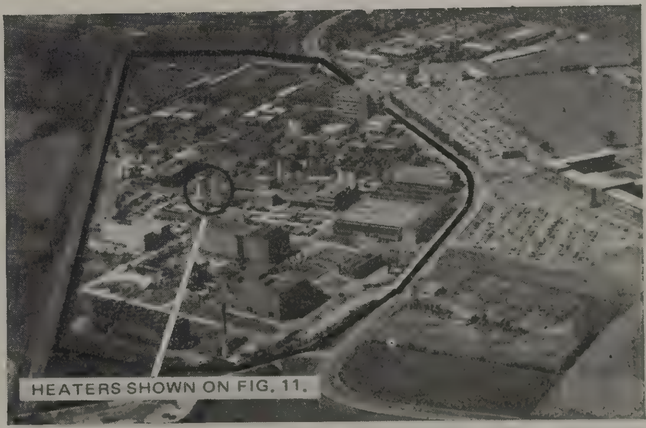

Fig. 14 *Rolls-Royce (1971) Ltd, Sinfin Test Establishment*

One does not have to be a combustion engineer to see the marked difference in the pattern and the more regular distribution of (b) to appreciate the improvements affected by this development work.

The result of this work can be clearly seen in Figure 10 which shows the reduction of Exhaust smoke in Rolls-Royce high-pressure engines over a ten-year period plotted against P.S.U. (Photo-smoke units) where 1 P.S.U. = 1 × 10^{-6} grams of carbon in 1 litre of gas. All engines in the bottom block meet the 1976 E.P.A. requirements and produce no visible smoke.

As you will appreciate none of these improvements have been brought about easily, in fact they are a time consuming and costly exercise and Figures 11, 12 and 13 show some of the equipment the combustion engineer has to use to carry out his investigations, these are (11) heaters to preheat air at 350 PSI—250 lb. sec. through 400°C, (12) the rig itself with combustion chamber in position and (13) the traversing gear used for obtaining the information shown in Figure 9. This gear carries, smoke probes—gas sampling probes, pitot tubes and a number of platinum-rhodium thermocouples for measuring temperatures, and its total weight is over 14 tonnes.

Reverting more to the industrial problem and our relationship with the local community, our main problems stem from the testing required to develop and prove our new products both civil and military, and to carry out all the ongoing development work. It can take between four to six years to bring an aircraft engine from its design stage to its first passenger flight and after that, development does not stop. There is a constant policy of investigation and improvement. For example, the Dart engine, the first civil gas turbine in the world, 1953, in the Viscount at a power of 1,000 horse power, since then over 6,500 have been produced and the power increased to 3,000 H.P. This engine is likely to be still in service in the next century. The Griffon engine, a piston engine from the 1939-45 war era, is still in service today, and we have recently carried out some modification approval work on it.

To carry out all this testing, we have at our Sinfin Test Establishment (Figure 14), 31 test beds, 22 Combustion and Aerodynamic Rigs and 55 Mechanical Rigs, plus the normal laboratories, machine shops etc., additionally we have the largest privately owned Altitude Test Facility in the western world, capable of simulating aircraft conditions up to 80,000 feet and mach 2.

Of these facilities, only 13/14 are used for what we would term straight forward production pass-off tests, that is running to a clearly defined schedule laid down by a licensing body. The res tare used for research, development and service fault investigation. For this type of testing it is necessary to work throughout the engine operating conditions and frequently at completely off design conditions.

For example, a licensing body may request a demonstration of the effect of a number of burners operating incorrectly. We may have to carry out tests to demonstrate the engine's ability to slam accelerate from idle to maximum take off conditions, the kind of manoeuvre which may be required in an emergency, producing rapid changes in noise level in the area. On military engines we have to operate with reheat. This means feeding in immense quantities of fuel into the tail pipe to give a rapid increase of power but with a temporary lowering of combustion efficiency. These are just a few examples of the many tests we have to carry out.

How do we attempt to make all these functions acceptable to the local community? Firstly we spend immense sums on silencing. When designing a test facility we aim to have a noise level measured at the inlet or outlet of no greater than 90 dB (A), this means on a site of this size (55 acres), acceptable day-time levels on the existing housing estates. An RB.211 Test Bed is 160 feet long, 40 feet high and 32 feet wide. All interior walls and ceilings are lined with sound absorbent intake silencers (Figure 15) and is exhausted via exhaust material. Air enters the Test Bed via sound absorbent silencers (Figure 15) and is exhausted via exhaust silencers, Figures 16 and 17, which are lined with sound absorbent material and also have internal co-axial sound proof splitters.

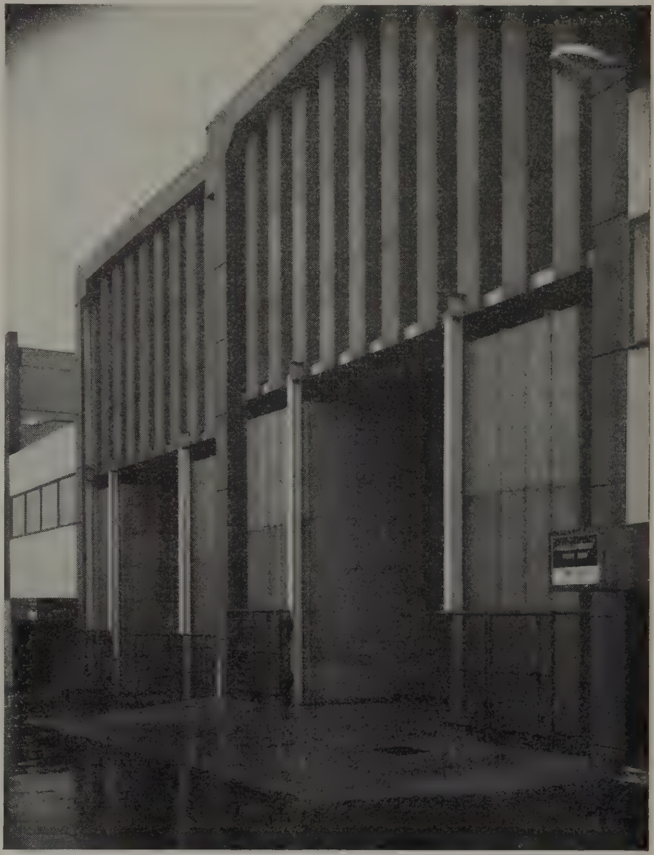

Fig. 15 *Test bed intake air silencers*

The cost of providing this silencing represent approximately 30 per cent of the total cost of any facility and in the case of the RB.211 this means over £100,000 for environmental sound proofing on each test bed. For the company this produces no returns, it does not help the testing, in fact the reverse is the case. Due to the pressure produced by the exhaust silencers it is necessary to make allowances in the test results for these factors and sometimes even to carry out cross calibrations against special open air facilities.

The smell/paraffin aspects are much more difficult to deal with. At the moment we know of no practical way to remove odorous particles from our detuners. Various types of washing or catalytic burning have been suggested, but the immensity of the problem can be seen from the following figures. The total airflow through a single RB.211 Test Bed is in the region of 1,750,000 cubic feet per minute at a velocity of 100 ft. sec., that is

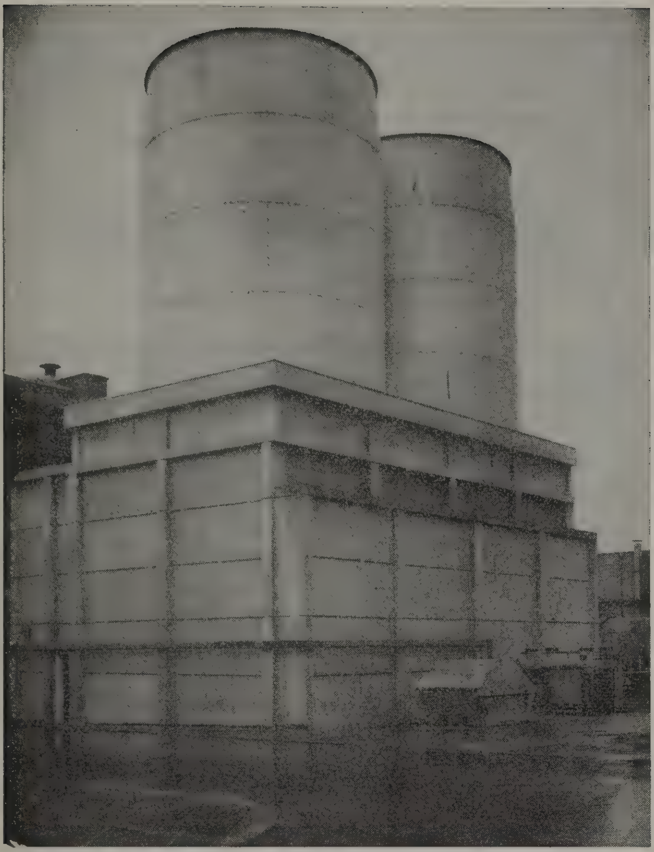

Fig. 16 *RB.211 test bed exhaust silencers*

70 m.p.h. This is equivalent to completely evacuating all the air from a building 1,000 feet long, 70 feet wide and 25 feet high, every minute. On a Spey Test Bed the figures though small are still formidable, 470,500 cubic feet/min. at a similar velocity. The important thing to remember is that we have to keep all this in perspective. We rarely, unless there is a break down of some kind, release more than minute quantities of odorous material into the atmosphere. Unfortunately as anyone who has spilt paraffin or has had an inefficient paraffin heater in the house will know, a small quantity will produce a a lot of smell which will hang about for some time.

Our line of attack on this subject has been to attempt to regulate certain types of testing to suit local atmospheric conditions. To do this we first had to decide which tests were the ones most likely to cause annoyance and we produced a list of all the possibilities. From this list we chose the main items which are as far as is practicable now controlled. These include for example, Re-heat checks, Rich and weak extinction checks, smoke sampling at off design conditions, Altitude climbs to extinction etc.

Fig. 17 *Aerial view of silencers showing co-axial sound-proof splitters*

We have our own weather station installed on the roof of the highest building in the area. The information from this is on line via the internal telephone system to every Test Bed and Rig in the area via a code system. Under very adverse conditions, e.g. when there is a strong inversion with a wind in a quarter which affects local housing estates, we curb *as far as is practicable* those tests which are known to be possible sources of annoyance.

We have found the biggest single weather factor to be the inversion pattern in the area. At the moment we get our information on a daily basis from Watnall Weather Station. However, we are currently purchasing and installing an Acoustic Radar which will give us instantaneous read-outs of the inversion pattern in the area. You may consider that this is purely cosmetic, but I can assure you it is not. Figure 18, a graph plotted from Watnall information, illustrates clearly the problem. The inversions plotted are those with a base on the surface and a top of no more than 1,200 feet and it can be seen that these occur on almost half the days in the year and have quite a long time duration. If we are to improve our control functions we shall need this more up-to-date information on this subject.

To help us with our pollutants problems we have appointed one of the leading consultancy firms in the country to advise us on the control of atmospheric emissions, and they are carrying out continuous investigations into the subject.

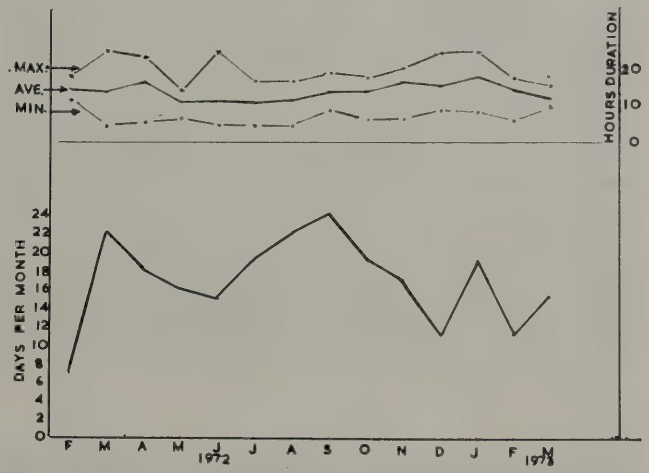

Fig. 18 *Inversion information supplied by Watnall Weather Bureau*

We have placed severe restrictions on our night-time operations to restrict noise pollution and in a similar manner to the odorous emission, we produced a list of possible excessive noise sources from which we selected tests which are now controlled, for example, we no longer run re-heat test beds at night-time. We have also limited RB.211 testing to medium and low speed work although it sometimes becomes difficult to explain to our customers why we cannot carry on full 24-hour testing. Our Altitude Test Facility no longer operates after 11 pm on any night and these are just a few examples. We have taken all these measures to reduce the night-time noise levels to below those recommended by B.S. and International Standards. This has, of course, reduced the possibility of night-time smell complaints.

All this has been done by the expenditure of considerable cost and effort by Rolls-Royce. For example, the stopping of A.T.F. testing at night has meant a complete change in our shift pattern resulting in higher shift premiums for the work force and a heavy increase in electricity costs. The facility has 135,000 hp of electric motors installed and as you know it is possible to obtain much reduced electricity charges by operating at night. In January and February this year, 1975, our electricity cost for operating it were £3,000 per day; if we had been able to operate at night-time this could have been reduced to £1,500 per day.

Nevertheless, we have accepted these restrictions along with others as part of our community responsibility. Even these self-imposed restrictions can bring problems. We occasionally inject water spray into our detuners to both cool the efflux and reduce noise levels. This sometimes produces a vapour plume; we then get people ringing in saying you are making a smell, when asked how bad it is, we have been told more than once 'Oh I can't smell it yet but I can see it!'

So far I have only mentioned our Sinfin Test Establishment and this is because as you will realise this is our potential problem area. We actually receive very few complaints about our total operation and hardly any about our other factories in the district. Though we do have problems at Hucknall with the noise from our open air test facilities.

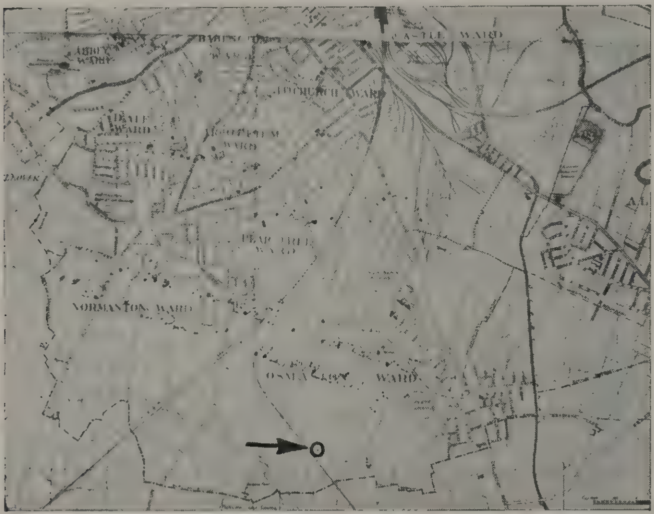

Fig. 19 *South Derby 1929*

We have in fact put into operation in the last four years what we believe is a classic example of planning to meet all the environmental problems. This is our Precision Casting Facility, located to the South of our Test Facilities. The facility is possibly the largest lost wax process casting facility under one roof in the western world. The building covers seven acres (320,000 sq. ft.) and produces 20-30,000 finished castings weekly. It is totally enclosed with a pressurised ventilation system and all process outlets are filtered. But even here in our quest for improvements we ran into problems. We began to receive complaints from householders about engine noises at times when investigations showed we were not operating. The noise 65 dB(A) measured at 2 am one morning some hundreds of yards from our boundary was found to be from the air conditioning system of the casting facility. This is of course now cured by lagging and soundproofing.

In this paper I have tried to show some of our problems and how we attempt to deal with them. Unfortunately being one of the major industries in the area with a reasonably well-known name we do frequently receive complaints which belong to other firms. This is I suppose a cross like other major industries have to bear.

Before finishing I would like to pose some questions. We as a company in line with most other major companies have the responsibilities I listed at the beginning. But does not the community have some responsibilities to the industries which bring it its livelihood and wealth?

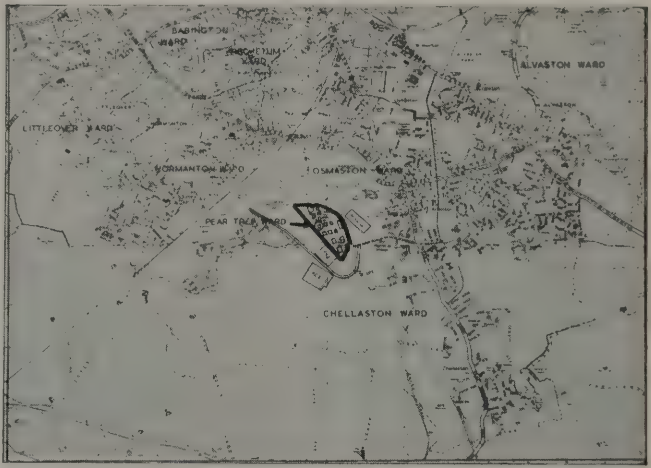

Fig. 20 *South Derby 1970*

I would point out that the problem, a serious one, is not peculiar to Rolls-Royce; it is happening to industry all over the country. The first map, Figure 19, shows the South of Derby as it was in about 1929. Round about the period that Rolls-Royce purchased some land to enable testing of certain kinds, to be moved away from the community into open country. This was a calculated move on the part of the management of the day, and remember at this time we were only talking of 600 hp piston engines. The site is shown by the arrowed circle. It can be seen that the nearest houses were to the East (right) of the site at what was then the village of Allenton. During the 1939-45 war the size of the site increased and the first jet engines were tested down here still with little bother. By 1970, however, the situation was that shown on Figure 20, this map is to a slightly different scale but the original building is again arrowed. Houses had by then moved close to the site on three sides, North, East and West, and occasional complaints about noise and smell are now received.

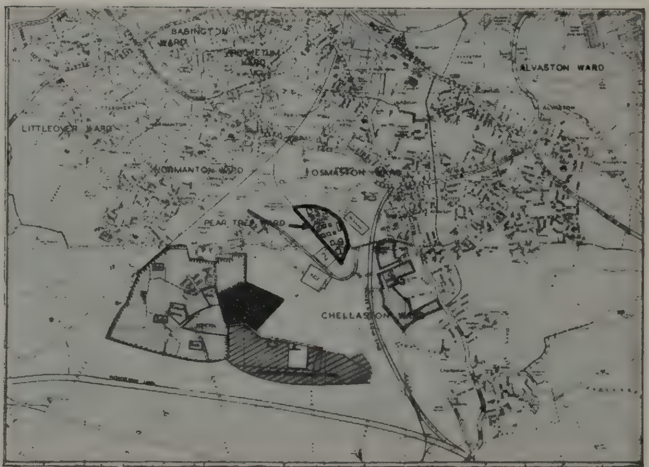

Fig. 21 *Proposed development of South Derby*

National Society For Clean Air

NEWS FROM THE DIVISIONS

EAST MIDLANDS

The Annual General Meeting of the East Midlands Division was held on 12th June, 1975, at the Civic Centre, Corby.

A Civic welcome was extended to the members by Councillor P. J. Floody, Vice-Chairman of the Corby District Council.

Under the Rules of the Division the Vice-chairman, Mr. J. Jones, Director of Environmental Health, City of Lincoln, succeeded to the Chair. In handing over, the retiring Chairman, Dr. R. V. Riley of the British Steel Corporation, referred to the satisfaction afforded by his own year of Office and wished Mr. Jones well in his capacity as Chairman.

In reply, Mr Jones referred to the current interest in smoke control in Lincoln and said he hoped that financial restriction would not lead to curtailment of progress in dealing with either atmospheric pollution or noise by local authorities generally.

Councillor W. Cashmore, Mayor of Peterborough, was elected as Deputy Chairman, and Mr. E. F. Raven was elected as Honorary Secretary. Mr J. B. Sheard was re-elected as Honorary Auditor with thanks for his past service. Councillor D. F. Haynes was elected to serve for three years on the Council of the Society.

At the end of the business section, a paper on Rehabilitation of Ironstone Workings by Mr. R. J. Cowan FRICS., C. Eng., MIMinE, and Mr. R. Dean ARICS, was presented by Mr. Cowan. The paper was supported and illustrated by slides and, at the end, Mr. Cowan answered questions. This paper will be reproduced in the next issue of this journal.

One of the visits arranged in the afternoon was to the British Steel Corporation where, among other items, members were shown how land is progressively reinstated after the iron ore has been moved.

SOUTH EAST AND CENTRAL SOUTHERN DIVISIONS

The 20th Annual General Meeting of the South-East and Central Southern Divisions of the NSCA was held at the Offices of the National Coal Board, Hobart House, Grosvenor Place, London, on 30th April, 1975.

Present were Mr. J. Clancey in the Chair, the Secretary General Rear Admiral P. G. Sharp and approximately 48 members and representatives.

Mr. T. Iddison was declared Chairman of the combined Divisions for the ensuing year and Mr. J. Clancey and Mr. R. Shapter were elected as Deputy Chairmen. Mr. B. C. Upton was re-elected as Honorary Secretary.

After the business meeting, a talk was given by Mr. J. S. Sawyer, FRS, Director of Research, Meteorological Office, Bracknell. His talk, entitled 'Some Aspects of Air Pollution on a Global and Continental Scale', is printed in another part of this issue.

NORTH WEST

The Annual Meeting of the North West Division was held at Pembroke Hall, Worsley, on Thursday, 12th June, 1975.

The Members of the Division were entertained to Luncheon by the National Coal Board and heard Mr. P. E. Daintith, Regional Manager of the Solid Fuel Advisory Service, speak on the aims of the Service.

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continued from facing page

The last map, Figure 21, shows the known proposals for development in the area. To the West (left) of the site there is an area (light grey) in which it is proposed to finally build approximately 4,500 houses, five schools, an Old Peoples Home and a Community Centre, and the first phase of this is already underway. The very dark area adjoining this development is the proposed site of a pleasure park! To the south of the site (darker grey with crossed lines) there is a large area of land earmarked for possible housing development. To the East the area (light grey) is already being infilled with houses. I will leave you to draw your own conclusions on the subject of *potential* noise and smell problems.

The real question is, should developments of this kind take place in areas of potential problems? The fears that legal action may severely curtail or in certain extreme cases completely stop the operation of an industry has drastic implications for the community as well as the firm concerned. One has only to have lived through a period such as 1971 in Derby to realise the communities' dependence on industry.

We naturally work closely with our Local Planning Authority on these problems, but must recognise that their own problems may not always permit them to recognise our point of view.

I suggest that in the future there should be legislation to deal with industries' difficulties, or we are perhaps in danger of being hoist with our own environmental petard.

Acknowledgements

The author wishes to acknowledge the assistance he has received from colleagues at Rolls-Royce and to mention especially Mr. G. M. Webb, Chief Photographer, for his advice and help in producing the illustrations.

CLEAN AIR

Change to Solid Smokeless Fuel

You'll breathe the easier afterwards

Current economical difficulties do not necessarily mean that you must postpone the Clean Air Programme. Even the most stringent budget can accommodate the considerable improvements that can be made *now,* with Solid Smokeless Fuels. For instance, it probably won't even be necessary to change the bulk of appliances in your area, as many of them are approved open fires capable of burning Solid Smokeless Fuels.

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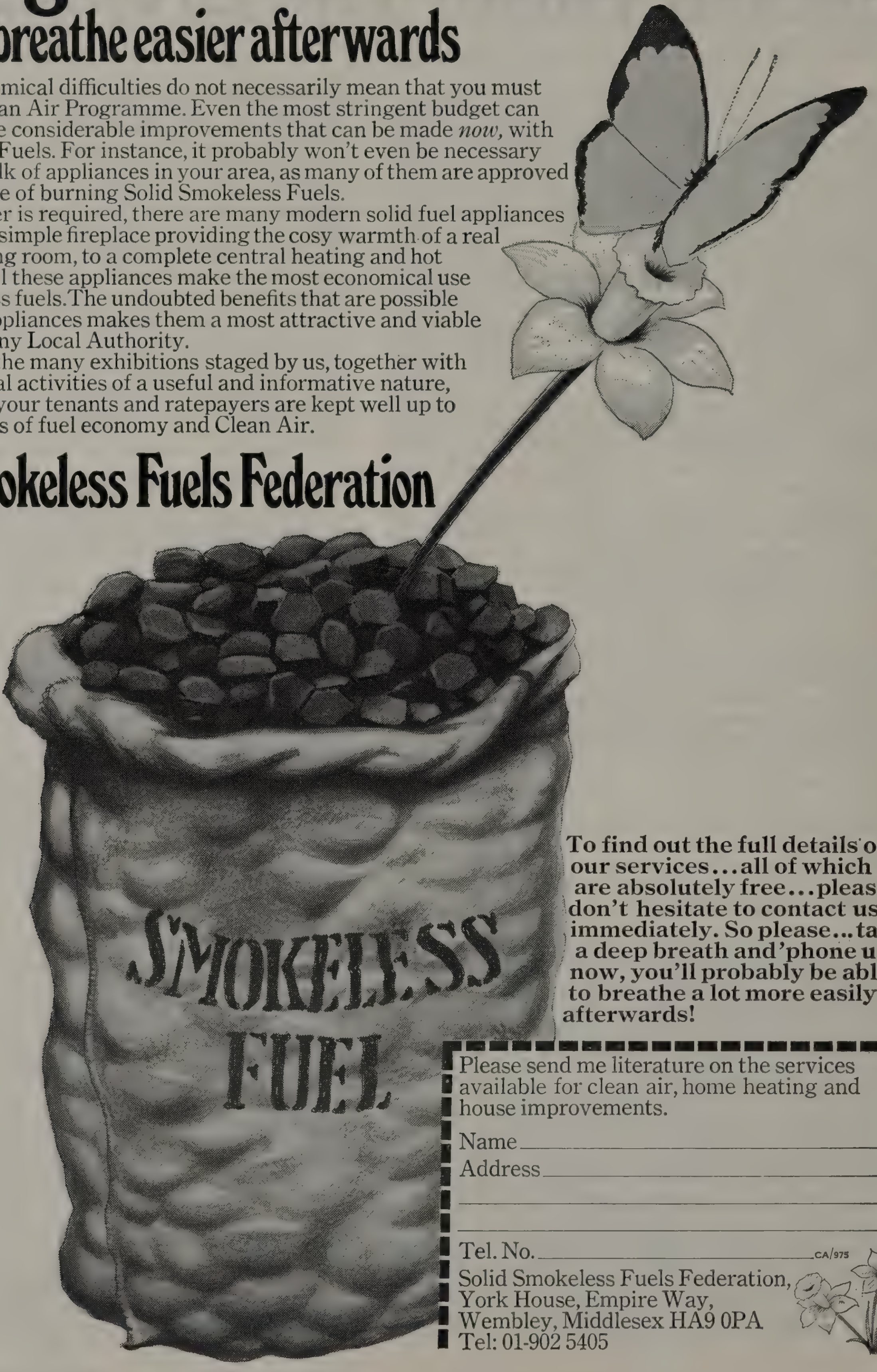
Additionally, the many exhibitions staged by us, together with other promotional activities of a useful and informative nature, will ensure that your tenants and ratepayers are kept well up to date in all aspects of fuel economy and Clean Air.

Solid Smokeless Fuels Federation



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Reader Enquiry Service No. 7578

"Air Knows No Frontiers"

INTERNATIONAL NEWS

NEW ZEALAND

April 1st, 1975, was the date set down in New Zealand's 1972 Clean Air Act for establishment of the first 'Clean Air Zone', a similar scheme to the U.K. Smoke Control Area. However, there was strong local opposition to the proposal put forward by the Christchurch City Council, partly because of lack of subsidy provision for conversion. This aspect is under review and it is not unlikely that some provision will be made for those who can show hardship.

One progressive action has been that the New Zealand Government has provided funds for domestic insulation to be financed by interest-free loans to householders, with an upper limit of $150 ceiling only or $300 walls and ceiling. These loans will be administered by Electricity Supply Authorities and repayment billed with the electricity account.

This action is hoped to save energy and also reduce pollution from domestic sources.

REPUBLIC OF SOUTH AFRICA

A four day International Conference on Air Pollution sponsored by the Department of Health of the Republic of South Africa and jointly arranged with the South African National Association for Clean Air, and the Council for Scientific and Industrial Research, RSA, will take place from 26th-29th April 1976, at the University of Pretoria, Republic of South Africa.

Topics covered will be: The control of smoke from combustion and development of trends in control of load vehicle engines in general; future fuel and energy sources; steel, ferro-alloy and non-ferrous metals industries; advances in the assessment of health effects of air pollution; the technology of new control equipment; the chemical and petrochemical industries; and all industries concerned with the abatement of air pollution.

Papers are invited on any of the topics listed in the paragraph above and prospective authors should inform the Conference Secretariat immediately. A summary of the contribution, consisting of not more than 300 words, should be despatched direct to the Conference organisers now for consideration by the Selection Committee. If a paper is selected for presentation at the Conference, the final paper should be limited to a maximum of 12 A4 typewritten pages.

The British Overseas Trade Board has stated that it is willing to make a contribution towards the expenses of anyone reading a paper, subject to a sight of the paper to be read.

Details can be obtained from: The Conference Secretariat, S.121, CSIR, P.O. Box 395, Pretoria, Republic of South Africa, 0001.

CANADA

World wide concern over heavy metals is reflected in the first International Conference on Heavy Metals in the Environment to be held at Toronto's Inn On The Park, October 27-31.

Hosted by the Institute for Environmental Studies at the University of Toronto, the conference has an impressive list of sponsors, including the U.S. Environmental Protection Agency, the World Health Organisation, the National Research Council of Canada and the National Institute of Occupational Safety and Health.

Topics will include: Analytical techniques, problems and standards; the pathways and cycles of heavy metals; human health effects and epidemiology, toxicity of specific metals and sources of problems.

Finally, panels comprising scientists and decision makers will discuss problems of standards and regulations, as well as attempting to anticipate the future. Delegates from more than 30 nations will attend.

Further details can be obtained from M. K. Ward, Executive Secretary, International Conference on Heavy Metals in the Environment, National Research Council of Canada, Ottawa, K1A 0R6.

ITALY

I.S.W.A.—The Congress of the International Solid Wastes and Public Cleansing Association will take place in Padova from 20-27th June 1976, accompanied by the exhibition SEP/POLLUTION in which thousands of technicians, experts, public administrators and private enterprises will meet in Padova for contacts and negotiations on the newest and most up-to-date systems and techniques for the handling of waste products and the struggle against pollution.

Padova has been chosen as the base for the I.S.W.A. 1976 Congress, since Padova Fairgrounds already handle the Sep/Pollution exhibition, well known both in Italy and abroad.

Details can be obtained from: The Secretary, I.S.W.A.-SEP/POLLUTION, Fiera Internazionale di Padova, via N. Tommaseo, 59, 35100 PADOVA, Italy.

FINLAND

The Environment Protection Department of the Ministry of the Interior is at present drawing up a bill on the protection of the air, based on a report submitted to the government last year by the Committee for Atmospheric Protection and Noise Abatement. The report suggests that the Central Meteorological Office should be made responsible for managing the network of observation and survey points, for research and for maintaining these installations. (Council of Europe Newsletter).

JAPAN

Nippon Kokan's Ogishima steelmaking complex, to be completed by the end of 1978, will be Japan's newest integrated steel production centre. The complex will have an annual capacity of some 6 million tons in terms of crude steel. Construction cost will total about £905 million.

It is the first example in Japan of wide scale replacement of facilities of existing steelworks. Thus, it will stand as an example for future investment by Japan's steel industry. Ogishima Island was expanded from 900,000 square metres to 5,500,000 square metres to accommodate the new complex. The island is located some 3 km off the works in the Tokyo-Yokohama industrial district.

Some 18 per cent of the total cost of the project will be for pollution control systems and devices. Among the measures will be those for SOx and others, industrial waste and waste water. The industrial water recirculation rate, is to be more than 93 per cent.

The control measures will enable meeting the very severe requirements of the local and central governments. These requirements are considered to be perhaps the most rigid in the world. In addition to pollution control creating a more pleasant working environment is another feature. There will be extensive greenery totalling 800,000 square metres, fully 15 per cent of the complex site.

4th International Clean Air Congress

The 4th International Clean Air Congress is being held from 16-20th May 1977 in Tokyo. It is being sponsored by the International Union of Air Pollution Prevention Associations.

Papers will be presented in five sessions. Five sections on the following topics will be set up: Biomedical Effects; Diffusion of Pollutants; Air Pollution Measurements; Researches and Control Programmes for Air Pollution; Air Pollution Control Technology.

The preliminary brochure is available from N.S.C.A., 136 North Street, Brighton BN1 1RG Tel: Brighton 26313.

USSR/FRANCE

An environmental exchange programme has been initiated by the Franco-Soviet group on co-operation in the environment field. The co-operation agreement for 1975-1976 has been signed on the basis of an examination of the 1973-1974 programme. It covers nine fields: air pollution, water pollution (continental, surface and subterranean waters), forms of pollution specific to industry, water purification, noise, protection of fauna and flora. There will be exchanges of documentation or of delegations in connection with the selected themes.

(Council of Europe Newsletter).

EEC BRUSSELS

Research projects on the effects of noise on man will be presented to the Council of Ministers as part of a second environmental research programme drawn up by the European Commission. The projects will provide the Commission with the necessary information for improving regulations already adopted by the Council of Ministers and drafting new proposals on the reduction of noise in the human environment.

(Council of Europe Newsletter).

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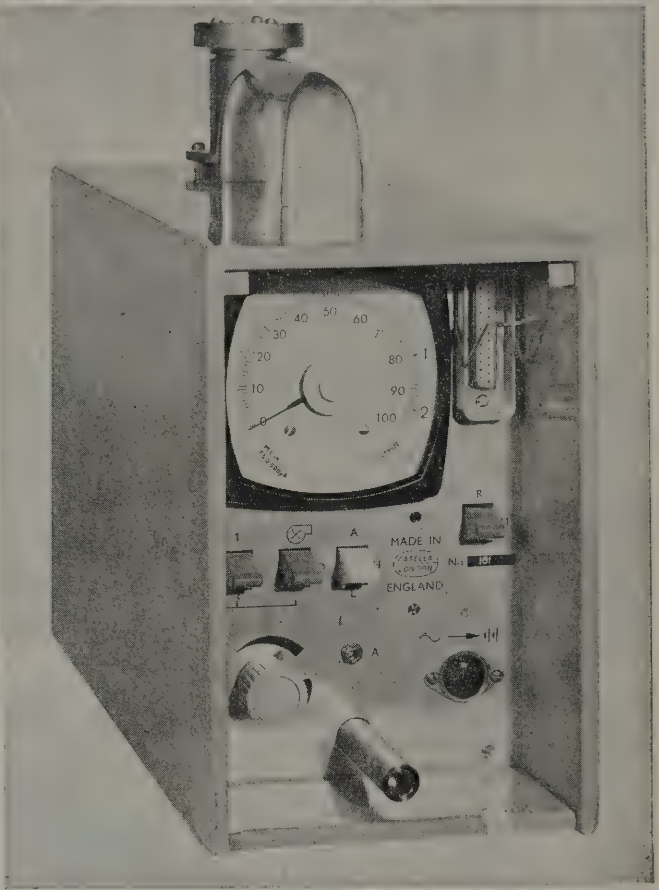

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CA 33

Reader Enquiry Service No. 7579

POLLUTION ABSTRACTS

1 **Primary and Secondary Particulates as Pollutants—A Literature Review.** Paul F. Fennelly. APCA July 1975.

This article discusses Primary and Secondary particulates with regard to their size, source, and chemical composition. Particulate size ranges from 0·005 μm to about 500 μm, i.e. from a cluster of molecules to a visible dust kernel. Primary particulates are injected directly into the atmosphere, their size ranging usually between 1 and 20 μm. Common sources of origin are windblown soil and sea salts; industrial emissions, including the grinding of metals and grain; and combustion sources. The author feels that insufficient research has been done on the chemical composition and size distribution of particles from potential sources of primarily particulates to provide a complete data summary or hazard assessment. Secondary particulates commonly have a size range of 0·01 μm to 1 μm. Size is governed by the rate of formation and removal. Some particulates, continuously formed, last only minutes before coagulating to form larger particles. Others have an overall life cycle estimated between 7 and 40 days, and are eventually lost in coagulation or rainout. Principal types of secondary particulates are sulphates, oxyhydrocarbons and nitrates, usually formed by the reactions of SO_2, NH_3, NO_2, H_2O and hydrocarbons, with sunlight. Meteorological conditions and topography strongly influence the formation of secondary particulates, which are prime sources for Aitken Nuclei, responsible for initiating condensation processes in the atmosphere. Chemical composition as a function of size needs more study to reveal the mechanism of formation. Actual formation has not yet been established and postulated mechanisms are discussed. Both health and aesthetic effects of particulates are summarised. There is mounting evidence to show a consistent relationship between exposure to particulates combined with SO_2 and impaired ventilatory function in children. US research indicates links between particulate polycyclic matter and skin cancer, lung cancer and contact dermatitis. Aesthetic and material damage is caused by particulates via the soiling and corrosion of metals, masonry and textiles.

Reader Enquiry Service No. **7580**

2 **Subsurface Disposal of Waste in Canada—III.** R. O. Van Everdingen. Environment Canada, Inland Waters Directorate: Technical Bulletin No. 82.

This study begins with the premise that subsurface disposal of industrial liquid waste by well injection is preferable to the pollution of surface waters, which are now strictly controlled. There are environmental and economic cost advantages to industry in subsurface disposal, although the geographical tie of raw materials in production imposes limitations in oil field operations, potash and salt industries. Classification of liquid industrial wastes is necessary to determine their suitability for subsurface disposal. The author cites disposal problems, e.g. the difficulty of predicting the behaviour of "natural" brines with "foreign" components in disposal formation. Waste can be rendered harmless by prolonged underground detainment but sometimes the process of degradation produces a more noxious, even toxic, substance. At this stage, it is unrealistic to speculate on the conversion of liquid waste to a useful resource, but research on its behaviour under subsurface pressure and temperature is essential. Criteria for safe disposal are discussed. Geological requirements for a potential disposal site include a layer of sufficient porosity, permeability and thickness to accommodate a reasonable injection rate of liquid wastes. Major faulting and folding renders the site unsuitable and hazards also arise from old mining and drilling operations. Canadian conditions require seismological studies to ensure stability of the site and prevent the danger of leakage. Detailed knowledge of groundwater hydrology, and the hydrochemistry of the proposed site is also necessary. Separation from useable groundwater, fossil fuel and mineral resources should be ensured to avoid encroachment or contamination. The author makes a detailed study of potential Canadian sites and concludes that waste injection subsurface operations should not be undertaken until extensive tests have been made to ensure safe conditions. Expenses for such tests are high and waste treatment for surface disposal could well be cheaper. Greater efforts should be made to find alternative methods of treating liquid industrial waste to render it suitable for surface disposal, and changes made in the plant processes themselves. 27 references, 7 plates, 6 tables.

Reader Enquiry Service No. **7581**

3 **Additional Pollution Control Powers.** R. G. Toms, B.Sc., F.R.I.C., F.I.P.H.E. (Member), from Water Pollution Control, 1975, Vol. 74, No. 3.

This paper was written at the Lords stage of the 1974 Control of Pollution Act and deals with Part (II) Pollution of Water. The author gives the history of the Bill, opening with various points from the Jeger Report 1970 and the comments of the Department of the Environment in 1972. The clauses of the Bill and their probable effects are examined. The author feels that a conflict of interest between Water Authorities and the MAFF is likely to arise in the control of tidal waters. The MAFF-sponsored Dumping at Sea Bill will divide control and leave the Minister and the Secretary of State to mediate. Confusion might also stem from application of the Good Agricultural Practice clause; certain pollution problems arise from traditional farming methods of drainage, fertilisation and waste disposal. In the section dealing with groundwater pollution the reference in the Bill to "specified underground waters" is contrasted with the 1963 Act, which limited control to certain *means* of pollution, but applied to *any* underground strata. Mr. Toms believes more knowledge of groundwater is needed to ensure that the specification will prevent widespread pollution. The lapse of control over water collected in mines once these have ceased to be worked is also regrettable. Turning to the section dealing with applications to make discharges, the author approves the keeping of registers for public scrutiny but hopes the information will be recent enough to be useful. Advertising applications in the Press under the Water Authority's name might link the discharges with the Authority. The process of application and appeal could prove protracted and costly as industries have nothing to lose by making an appeal against an order to cease discharging or effect treatment, and are now faced with tougher penalties. The Injury to Fauna and Flora Clause is welcome but demonstrates that the Bill reflects the growing demand to protect the environment rather than the single-minded purpose of protecting the water supply. It introduces controls which have been necessary for many years, but the diverse views of industry, conservationists, the DoE and the MAFF have all to be considered in its enforcement. This will be as difficult for the Water Authorities as it will be for them to ensure the application of the same standards to themselves as they impose on others.

Reader Enquiry Service No. **7582**

4 Environment of the 70's—Noise Abatement Zones. R. T. Govett, M.A.P.H.I., A.R.S.H. Environmental Health, May 1975.

This paper reflects on the requirements necessary to introduce Noise Control Areas with a standardization comparable to that of Smoke Control Areas. To produce an acceptable ambient noise level, the Local Authority must be able to control noise within designated areas, ensuring that a level which will not cause nuisance or intolerance to the public, at large or at home, shall not be exceeded from defined premises. The author debates the inclusion of domestic premises within this definition; industry obviously ranks top priority, but a defined acceptable standard common to domestic premises, with modification for type and density, could be operated within the zone. The selection of zones with regard to the activities of industry, commerce, transport and leisure facilities is examined. The degree of noise levels from each source produces a consequent variation in standards. Mr Govett's experience in a 1972 noise appreciation of the Neasden Underpass enables him to reflect authoritatively upon the efficient spacing of observation sites. He advocates the use of B.S. 4142: 1967, and the use of L50 as the acceptable level. Noise contour lines within the area, with allowance for land and air traffic, should provide a sound framework for a commonsense approach to noise reduction.

Reader Enquiry Service No. **7583**

NEW FUEL ADDITIVE FROM CCL

Combustion Chemicals Ltd. recently released details of a new industrial fuel additive. Known as 'MM' (Manganese/Magnesium), it has been under development since 1973 and CCL say it is giving the best results of any product in the company's history.

The MM additive incorporates soluble manganese, soluble magnesium and complex alumina anti-sludge compounds, carried in powerful solvents to ensure complete dispersion of the chemicals with the fuel. Suitable for all types of oil-fired boiler plant, land and marine, MM has been subjected to trials in 18 establishments in England and Wales. The results obtained have shown higher combustion efficiencies, elimination of acid smuts, reduction of fouling and corrosion, reduction of smoke and saving of fuel. These results surpass any achieved by other industrial fuel additives.

MM can be used as an injection additive, metered into the fuel line before the burner, enabling the product to be evaluated on a single boiler. Being completely soluble, MM has also proved to be an ideal Tank Additive, fed into the tank before an oil delivery.

The specially activated manganese in MM acts as a combustion catalyst and promotes more complete burn-out of the fuel, so that less excess air is required for the combustion process. This limits the conversion of SO_2 and permits lower back-end temperatures, and increased combustion efficiency without increase in smoke number and with consequent fuel saving. As a result, soot and smoke formation is reduced to a minimum and stack emission is controlled.

The magnesium compounds in MM raise the ash fusion temperature of the fuel oil, thus preventing vanadium slagging in the high temperature zone and plate out on the heating surfaces of the boiler, retarding or preventing the catalytic conversion of SO_2 to SO_3. They also neutralise sulphuric acid which, with the reduction of unburnt carbon, effectively controls acid smut emission.

The special solvents in which the principal chemicals in MM are carried, condition the fuel and ensure control over sludge formation with consequent fuel saving, and control over burning coking.

The recommended dosage rates of MM vary between 1/2000 and 1/4000, according to the application and results required.

Reader Enquiry Service No. **7584**

NIFES introduce 'First-Aid' scheme for limited budgets

In recognition of the growing need by industry and commerce for a practical energy service, National Industrial Fuel Efficiency Service (NIFES), the largest independent fuel economy organisation in Europe, have launched a 'First-Aid' energy advisory service which they are offering for a nominal sum with the object of providing quick savings. It is expected that the scheme, which is a compact version of NIFES' comprehensive service, will appeal to a wide cross-section of small to medium sized industrial and commercial undertakings who have hitherto been restricted from seeking such aid because of insufficient funds.

The 'First-Aid' service is in two parts: a Site Survey and a Follow-up report.

The Site Survey involves the inspection of energy-using systems by a NIFES engineer to bring to the attention of management the areas of waste and to discuss not only the specific problems of practical remedial action required, but also the priorities of energy saving measures.

Recommendations arising from the engineer's visit will be confirmed in a concise, technical Report, which would be absolutely confidential.

NIFES say that savings in the order of 10% can be shown to be possible by applying basic 'First-Aid' measures and that, bearing in mind that industry, commerce and public bodies are expending some £5,000 a year on fuel, the potential saving could be around £500 million annually.

The 'First-Aid' service is provided for a fee of £50 and is available to users of fuel within a radius of 75 miles from the nearest NIFES office, of which there are 10 throughout England, Scotland and Wales. Consumers outside this radius should contact any NIFES office direct. The offer remains valid until 31st December, 1975.

Reader Enquiry Service No. **7585**

CLEANER AIR

1975 marks the founding of the Royal Observatory at Greenwich 300 years ago. During commemorative celebration at Herstmonceaux, Sussex, Princess Anne unveiled a bust of John Flamsteed, who established the Royal Observatory at Greenwich in 1675.

Shortly after the 1939-45 War, it was decided to move the telescopes and equipment of the Royal Observatory from Greenwich to Herstmonceaux Castle, on account of the smoke and atmospheric pollution which hampered observations within the London area.

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Reader Enquiry Service No. **7586**

INTERNATIONAL CLEAN AIR AND POLLUTION CONTROL CONFERENCE

incorporating the 42nd ANNUAL CLEAN AIR CONFERENCE

20th—24th OCTOBER 1975

THE DOME, BRIGHTON

OPENING SESSION—MONDAY, OCTOBER 20

Civic Welcome by the Mayor of Brighton.

Opening Address by Professor K. Shiozawa of Japan.

Presidential Address by Professor P. J. Lawther.

SESSION TWO—TUESDAY, OCTOBER 21
INTERNATIONAL ATTITUDES TO THE CONTROL OF POLLUTION

A Comparison of Approaches.
Dr. L. E. Reed, Department of the Environment, Central Unit on Environmental Pollution.

The United Kingdom Approach and its Application.

(a) By Central Government.
M. L. Tunnicliffe, H.M. Deputy Chief Alkali and Clean Air Inspector,

(b) By Local Government.
T. H. Iddison, M.B.E., Chief Environmental Health Officer, Dartford.

The European Approach and its Application.
The E.E.C. Philosophy of Application.
S. Johnson, E.E.C., Environment and Consumer Protection Service, Prevention of Pollution and Nuisances Division.

The E.E.C. Approach to Medical Standards.
Dr. P. Recht, E.E.C., Directorate General for Social Affairs, Health Protection Directorate.

A New Approach to Standards.
Dr. L. A. Clarenburg, Rijnmond Authority, Director of Department of Environmental Hygiene, Netherlands.

SESSION THREE—WEDNESDAY, OCTOBER 22
ENERGY FROM THE CONTINENTAL SHELF

Exploration.
J. M. Bowen, Director (Exploration) Shell Exploration and Production Ltd.

Production and Pollution Control.
F. G. Larminie, The British Petroleum Co. Ltd.

North Sea Oil—In Context and Perspective.
H. B. Greenborough, Chief Executive, Shell Mex and B.P. Ltd.

SESSION FOUR—THURSDAY, OCTOBER 23
TECHNICAL ASPECTS OF THE CONTROL OF INDUSTRIAL POLLUTION

(a) Gaseous Emissions.
J. P. Detrie, Director, Centre Interprofessionel Technique d'Etudes de la Pollution Atmospherique, France.

(b) Effluents.
Dr. F. Malz, Emschergenossenschaft, W. Germany.

(c) Solid and Toxic Wastes.
R. A. Fish, Greater London Council, Scientific Branch.

SESSION FIVE—THURSDAY, OCTOBER 23
CONSERVATION OF RESOURCES

(a) Human Resources.
Professor C. E. Barthel, Jr., Miami University, U.S.A.

(b) Energy and Raw Materials.
Professor F. Roberts, Brunel University.

SESSION SIX—FRIDAY, OCTOBER 24
POLLUTION FROM ROAD VEHICLES

(a) The E.E.C. Philosophy of Control.
D. Verdiani, E.E.C., Directorate General XI.

(b) The United Kingdom Philosophy of Control.
Dr. Stuart Reed, Greater London Council, Scientific Branch.

(c) The Technical Problems of Control of Pollution and Noise.
D. Collins, Ricardo & Co. Engineers (1927) Ltd.

CLOSING SESSION—FRIDAY, OCTOBER 24

12.00 CLOSING ADDRESS—The President.

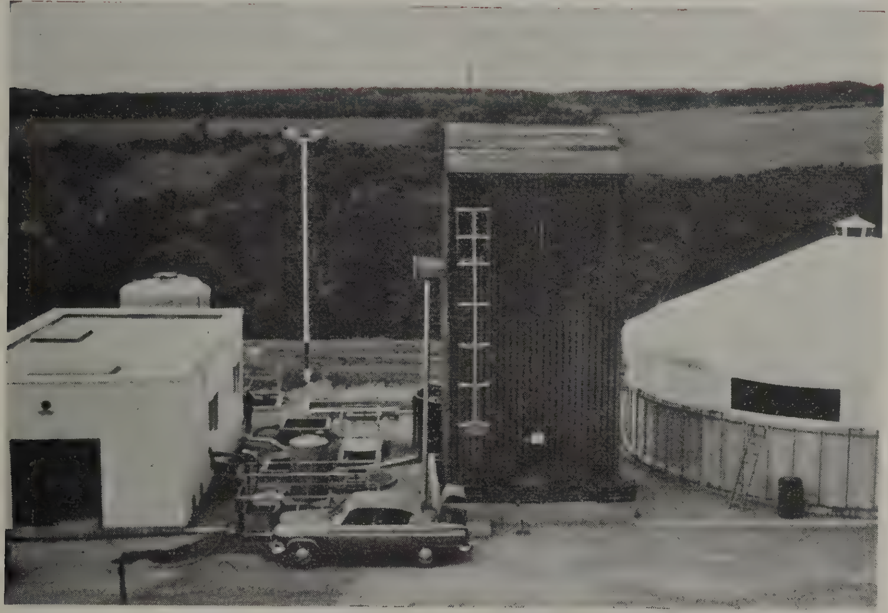
Programme of films about pollution will be shown in the Pavilion Theatre at 14.30 on Tuesday, October 21, at 16.30 on Wednesday, October 22 and at 14.30 on Thursday, October 23. A special programme of films on specific subjects will be shown at 16.30 on Tuesday, October 21, and a programme about North Sea oil will be screened at 14.30 on Wednesday, October 22.

The Social Programme will include visits to the Roman Palace, Fishbourne; Kipling's House, Batemans; Petworth House; Sheffield Park, Horsted Keynes and a trip on the Bluebell Line, on October 22; Preston Manor and Brighton Corporation's Nursery Gardens, Stanmer, on October 23.

The Civic Reception and Dance will be held on October 23 at the Royal Pavilion by courtesy of the Mayor and Corporation of Brighton.

Registrations may be made at the N.S.C.A., 136 North Street, Brighton BN1 1RG.
Tel: Brighton 26313. The Conference fee is £30 plus £2.40 VAT.

INDUSTRIAL NEWS



Making distillery waste water fit for fish to breed in

The waters of Mulben Burn in Banffshire are rigorously protected by the Banff Moray and Nairn River Purification Board because the Burn is a spawning ground for salmonid fish. They therefore imposed stringent regulations on the quantity and quality of the effluent discharged into the Burn from the new Auchroisk Malt Whisky Distillery at Mulben, near Keith, in the County of Banffshire.

The volume of water flowing in the Burn is not high, therefore the following conditions for discharge have been imposed:

pH between 5 and 9
less than 15 mg/l of BOD_5
less than 20 mg/l of suspended solids
less than 3 mg/l of phosphate (as PO_4)
less than 20 mg/l of nitrate (as N)
no substances that are harmful to the flora and fauna in the stream
maximum discharge rate of 1300 gph

A biological waste water treatment plant designed and constructed by Davenport Engineering Co Ltd was chosen as the obvious way to keep within these limits.

For design purposes the loading to the plant has been taken at 110 kg/BOD/day at a flow rate of 142 m^3/day. The effluent which consists of spent lees, washings, boiler blowdown and domestic sewage, is normally at ambient temperature, but high temperature waste waters are occasionally discharged from the distillery. However, the system is so designed that adequate cooling occurs before the biological treatment stages are reached.

Within the plant the wastewater is conveyed to the balancing tank through two pipes: one pipe carries the spent lees direct to the balancing tanks, whilst the other carries the washings, domestic sewage and boiler blowdown, etc, into the balancing tank via a comminutor which cuts up any large solid material. Stratification of wastewater in the balancing tank is prevented by a pump which withdraws wastewater from the tank and returns it at the opposite end. This action also homogenises the contents, mixing acid and alkali wastes, weak and strong effluents and hot and cold discharges. The homogenised wastewater is then pumped at a constant rate from the balancing tank to the neutralisation and nutrient mixing tank where the pH is measured. If the pH indicates that the wastewater is acid, lime is added to bring it to about neutrality. In the case of alkali flows acid is added. Should lime addition be inadequate or if the wastewater is strongly alkaline, an alarm system alerts the operator.

Because the nature of the wastewater is such that it is deficient in two of the major biologically required nutrients, ie, nitrogen and phosphorus, these are added as a solution of mixed ammonium and phosphate salts prepared in the necessary nitrogen to phosphorus ratio of 5:1.

The neutralised forward feed overflows from the mixing tank into the first of the two pairs of recycle tanks, from which it is pumped, together with the required cycle, to the high rate biofilter which is packed with Flocor, a plastics media marketed by ICI Pollution Control Systems. The liquor is evenly distributed over the Flocor plastics packing by means of a trough system with down-tubes discharging jets of liquor on to splasher plates. The liquor flowing over the media promotes the growth of bios, which absorb the putrescible matter in the liquor and reduce the BOD by over two-thirds. Excess bios is carried out of the tower with the liquor and, if not recycled, is removed in the interstage settlement tank. Accumulations of sludge in the settlement tank are periodically transferred to the sludge holding tank via the sludge sump, while the clarified liquor overflows into the second pair of recycle tanks.

The feed to the second recycle tank, together with the required recycle, is pumped over the stone filled percolating filter via a rotating distributor. The run-off from the percolating filter enters the collecting sump before being pumped to the final settlement tank. Settled sludge is again periodically transferred to the sludge holding tank via the sludge pump. The clarified liquor returns to the recycle tank.

The liquor not required for recycle flows by gravity to the duplicate pebble bed clarifiers, where it is distributed by swastika pipework assemblies before rising through the beds. Overflow from the bed enters the recorder tank, passing over a V-notch flow meter before final discharge at the Burn. It is necessary to flush the pebble bed clarifier periodically by pumping water from the recorder tank through the clarifier at a high rate. These washwaters are returned to the balance tank.

The sludge holding tank is provided with sypernatant draw-off ports and a pump for the delivery of sludge to a remote tanker point. Because of the cold temperature in the winter months both biofilters are roofed. The high rate biofilter possesses a roof integral with the cladding while the percolating filter has a domed GRP roof.

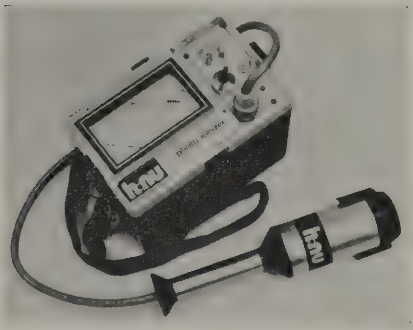
Reader Enquiry Service No. **7587**

New Vinyl Chloride Monitor

Anacon (Instruments) Limited announce the introduction of a new, portable trace gas analyser capable of measuring the presence of vinyl chloride down to 0·1 ppm.

The instrument, developed by NHU Systems Inc., operates on the detection principle of photoionisation and is virtually a specific analyser for vinyl chloride being unaffected by VC starting materials such as ethylene or VC by-products such as ethylene dichloride. Neither does it respond to methane, present at ambient levels of one to two parts per million.

Having a minimal warm-up time—90% response in less than five seconds—and operating for some ten hours on internal re-chargeable batteries and weighing only 4½ kilograms, it is well suited to either survey or monitoring applications· It is simple to operate and safe as it does not require the use of a flame or hydrogen fuel and the vinyl chloride sensor is located at the sampling point. At present the instrument satisfies the requirements of Class 1, division 2 of NEC regulations.



The inherent sensitivity to 0·1 ppm and rapid response make the instruments well suited to the task of detecting small leaks in vinyl chloride monomer plants as well as for monitoring areas around PVC extruders, calender mills and wherever PVC is being worked. These factors together with minimal zero and span drift and excellent reproducibility make the VC monitor ideal for quantitative survey work to ensure compliance with regulations limiting maximum allowable concentrations of vinyl chloride in air.

Reader Enquiry Service No. **7588**

New Bag Filters

A new bag filter in which the bags are cleaned by water spray instead of by the conventional methods of air jets or mechanical shaking, has been developed by Aercon Filtration Ltd. to eliminate the risk of fire or explosion when filtering dust, fumes and gases from chemical plant, foundries, glass works, coal-processing plant, incinerators and general engineering workshops. Efficiency is said to be 99·9%. Capital cost is equivalent to that of an air-cleaned bag filter of the same capacity. Less than 5% of filter area is off-stream for cleaning at any one time. Other advantages claimed are low water consumption because of recirculation; simple disposal of collected dust as low volume sludge; few moving parts and minimum maintenance. The Aercon 'Irrigated' bag filter is said to be the first fully automatic commercially-sized irrigated bag filter in the world. Final design was evolved in late 1974 by Mr. A. Akenhead, the Managing Director of Aercon Filtration.

The first plant of this type has recently been commissioned in Salford, Manchester, to handle zinc oxide and carbon fumes at approximately 285 m^3/min (10,000 ft^3/min) from an electric induction furnace melting scrap brass. Measurements at the plant outlet—only 100 metres from blocks of flats show less than 0·005 grains per cubic foot which is ten times less than the maximum allowed by the Alkali Inspectorate. The outlet need not therefore be high, even in a residential area; in this instance, it is only half the plant height. The total installation measures 5m × 2·5m × 6·5m high (16ft × 8ft × 21ft)—lower than the height of a conventional plant with dust hopper.

The Salford plant contains 200 vertically-arranged 150mm (6in) diameter filter bags in 20 rows of ten. Each bag extends from the top of the plant for two-thirds of its height. A water spray nozzle is fixed above each bag. At pre-arranged intervals, or continuously if the load is very high, solenoid-actuated valves (one per row of bags) are opened to operate the sprays. The spray is directed at the inside surface of the bag, so washing the filtered fume down to a water-trough in the base of the plant. If required, heaters can be used to raise the temperature of the water, and an additive incorporated to help move the dust.

Water consumption of the Salford plant is only 450 litres (100 gallons) per 6 day week a full load. This low consumption is achieved by recirculation and by using only the minimum water required to form a sludge. Because of this and the fact that the volume of collected dust in water is less than when dry, residue-disposal is simple. A conventional sludge-removal mechanism, incorporating a standard drag-chain and scraper-bar, is used. Because the chain moves at only 1m/min (3ft/min), wear is minimal.

The only other moving parts throughout the plant are the exhaust fan/motor, water pump, valves and solenoids. Since the solenoids do not operate in a dust-laden atmosphere, they are unlikely to fail; furthermore, there are less of them than in a dry bag filter. Ample access panels are provided. Because the bags are not subjected to mechanical action for cleaning, they are less likely to burst, and the normal areas of weakness (i.e. where metal rings are sewn into the fabric to hold the bags open) are not subjected to strain. But if one should burst, it is only necessary to shut down the plant for a few minutes and to insert a temporary sealing plate. At the base of each bag, a simple clamping mechanism fixes the bag outlet to a plate which separates the clean and fume-laden areas of the plant.

The Salford plant was supplied in two sections in order to simplify transport and erection. This took one week including all connections and full commissioning. Because the plant is free-standing, it can easily be removed to another site if required.

Reader Enquiry Service No. **7589**

UV illuminated long path gas cells designed for atmospheric studies of smog formation

Variable pathlength gas cells designed and manufactured by Wilks Scientific Corporation have been introduced by Techmation Ltd. They can be adapted to provide ultraviolet illumination of the cell contents for the study of photochemical reactions in simulated atmospheres. Ultraviolet radiation is introduced while infra-red analysis is taking place and photochemical reactions, such as smog formation, can be monitored as they occur.

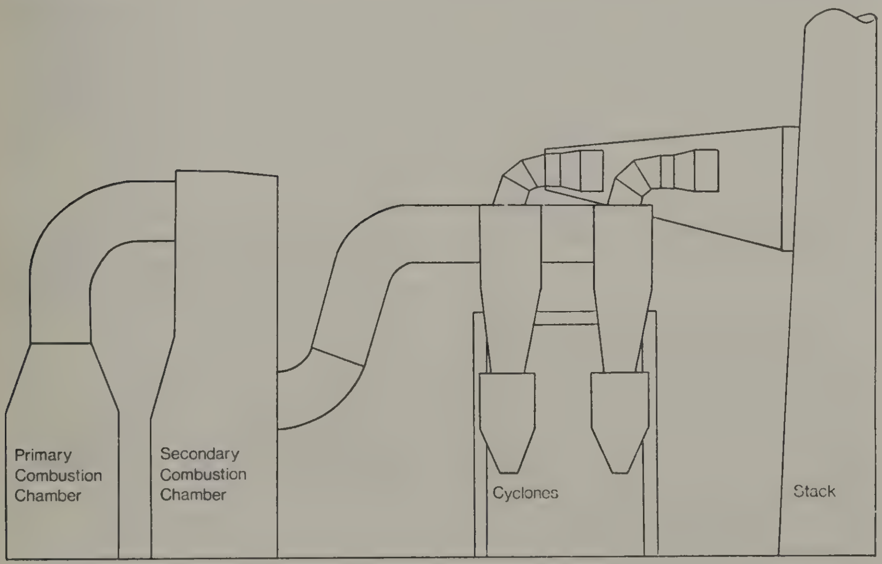
Solar radiation, particularly in the ultraviolet range, is an effective agent in fragmenting molecules or in exciting them electronically and will interact with all gases in the atmosphere. This ultraviolet energy produces neutral atoms and excited molecules and brings about chemical reactions between these and unaffected chemical particles. As an example, colourless gaseous pollutants released by internal combustion engines such as nitrogen oxides pass through a complex chain of reactions to result in the visible brown haze found in metropolitan areas with pockets of stable, relatively motionless air.

The Wilks Scientific long path gas cells with UV illuminators are used by scientists to study reactions of trace substances in parts per million concentrations. Simulated atmospheres are fed into the long path cells and the concentrations are measured with an infra-red spectrophotometer. Ultraviolet illumination is introduced through a special quartz window in the side of the cell and reflected from an aluminized glass mirror to illuminate the cell contents. In this way, specific reactions, reaction rates, and yields can be determined by infra-red spectroscopy.

Available in maximum pathlengths of 20, 40 and 120 metres, the cells use a folded optical path to provide long optical paths inside a small chamber. The total cell pathlength can be varied by adjusting an external knob for optimum analysis sensitivity, evacuated for cleaning between experiments, and heated to study thermal effects.
Reader Enquiry Service No. **7590**

Incineration—the complete answer for many liquid wastes

Recent public and political disquiet at the dumping of waste liquids in worked-out quarries and gravel pits has led many organisations to investigate one of the main alternatives—incineration.



The Hargreaves Clearwaste Treatment Centre at Wakefield leads the way in this trend with the installation of a complex including Peabody Holmes incinerator system.

Fully automatic in operation, the system can deal with 300 gallons of sludge waste or 300 gallons of clear waste and 1,000 gallons of aqueous waste every hour.

The incineration plant comprises primary and secondary waste incinerators together with cyclone grit collectors and chimney.

The primary vortex incinerator is designed for burning waste oils and sludges having high calorific value in order to generate heat for the secondary incineration stage. The burners fitted to this incinerator are divided into three groups, one for the start-up fuel, the second group suitable for relatively clean waste oils and final group suitable for waste sludge and oil containing solids, which would block a conventional burner.

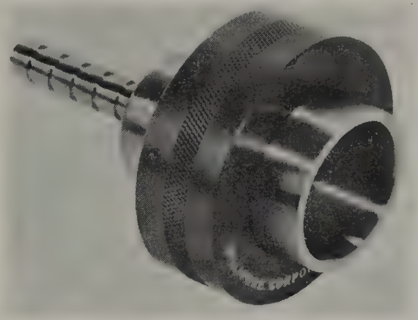
The clean waste oils are fed to conventional Peabody mechanically atomised burners fitted to the primary combustion chamber. The heavier waste sludges containing solids are directed to specially designed air atomised burners with large fuel passages to minimise the chances of blockage. Combustion air is provided by a forced draught centrifugal fan connected by a set of ductwork to the incinerator. This air enters the incinerator through a series of tangential ports and mixes with the waste fuel to complete combustion.

The secondary incinerator is designed to handle a waste slurry resulting from the neutralisation of acidic liquors which arrive from the Hargreaves waste water treatment plant on the same site. This waste slurry is sprayed into the top of the reaction chamber where it mixes intimately with the hot exhaust gases from the primary incinerator. These hot gases are introduced tangentially creating a toroidal air flow pattern within the reaction chamber. The gases leaving this chamber are further quenched with air to ensure that all particulate matter in the gas stream is in a solid state before the gases enter the cyclones.

The high efficiency cyclones are designed to remove particulate matter from the gas stream prior to exhausting into the stack.
Reader Enquiry Service No. **7591**

Monitoring airborne contamination

Urban industrialization, increased use of motor vehicles, asbestos insulation, welding, plating and grinding operations, etc., have all led to an increasing concentration of toxic constituents in air. Whilst standards may differ from country to country, the most generally accepted method of monitoring airborne contamination is based upon the use of membrane filters for sample collection.



Millipore mebrane filters are ideally suited for air sampling, and their absolute surface retention characteristics allow quantitative estimations to be made. Moreover, they may be used in a variety of different procedures since they are an accepted standard of precision in the majority of British and international standards.

Basic sampling equipment consists of a Millipore membrane filter, filter holder, limiting orifice and Vacuum Pump. Sometimes, a flow meter replaces the limiting orifice. In operation a measured volume of air is drawn through the membrane filter at a fixed flow rate. This is controlled by either the limiting orifice or flow meter.

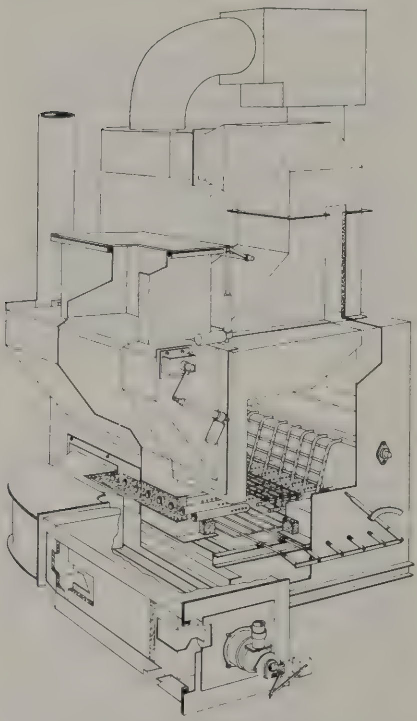
Airborne particulates are collected, absolutely, on the membrane surface. The collected material can thus be readily subjected to suitable and further analysis, eg, particle counting, atomic absorption, gravimetric or chemical analysis, etc. As an aid to particle counting, filters are available with a grid marked surface.
Reader Enquiry Service No. **7592**

Fluidised-Bed Industrial Incinerator Has Wide Sphere of Applications

A package-type incinerator which overcomes the problems normally associated with the disposal of wastes difficult to burn by traditional methods has been developed by the Energy Equipment Company. Based on the fluidised-bed principle and suitable for use by industrial concerns, hospitals and similar large institutions and on board ship, it automatically maintains the high temperatures and intimate style of burning necessary for the destruction of difficult wastes without in any way impairing the environment, the emission to atmosphere of pollutants having been virtually eliminated.

Designed to burn some 600 lb. of high calorific value waste an hour at operating temperatures up to 900 deg. C., the bed is composed from graded sand or similar granular inert material. Air is passed through this at sufficient velocity to cause it to behave as a liquid, "boiling" taking place in very much the same manner as with boiling water.

The incoming air is preheated to bring the bed up to a temperature sufficient to ignite the incoming waste and if this has sufficient calorific value to maintain combustion without assistance, then the preheater is automatically shut down. Conversely, if the temperature of the bed falls due, say, to a reduced rate of feeding, then the preheater is automatically brought into operation again to maintain the optimum operating temperature. Control of the preheater is effected by a monitoring thermocouple in the bed and the temperature of the preheated air is modulated by a further thermo-couple situated in the air stream.



The bed which is square has a surface area of 16 sq· ft. and when aerated to "boiling" point, a depth of 18 in. Maximum air flow is 2000 cu. ft. per minute and the air is distributed through the bed by means of multiple ported pipes, known as sparge pipes, located in its base. Air is supplied by a Rootes blower and enters the sparge pipes via the preheating combustion chamber which can be fired either by oil or gas. The bed is supported by a series of parallel flat plates pivoted at the ends so that they can be turned through 90 deg. in the manner of louvres to drop the bed into a lower chamber for periodic cleaning and sieving.

Waste materials are fed to the incinerator through an air lock. This is designed so that both doors cannot be opened at the same time and all parts of the system subjected to radiated heat from the bed are protected by refractory material. Products of combustion pass first to a hot cyclone for the removal of any solids carried over and then to a water wash which cleanses the gases further and cools them to an acceptable temperature for discharge to atmosphere.

If required, a heat exchanger can be installed after the hot cyclone for preheating the incoming fluidising air and thus reduce preheating fuel consumption. Furthermore, the design is such that the refractory lining of the combustion chamber can be replaced by a water wall so that, when operating conditions render it economical, the waste heat can be used either for a hot-water heating system or medium pressure steam generation.

As many wastes contain incombustible items such as tin cans and bottles, a means is provided for their removal from the bed while the incinerator continues to function. This consists of a multi-tined fork, the tines of which are bent almost at right angles so that they first dip down one side of the bed container and then extend horizontally across the bed with the tines located between the sparge pipes. A grid welded to the tines spans the sparge pipes and to remove the accumulated incombustibles the bar to which the tines are joined is rotated. This causes the tines to move upwards through the bed and as they reach the top limit of their travel, the collected incombustibles gravitate down them into a discharge chamber accessible through a refractory lined door·

The tines are hollow and are kept cool by air circulated through them under pressure which, when released into the bed, supplements that distributed through the sparge pipes. Because of the high operating temperature, all debris collected from the discharge chamber is completely sterile, an important factor so far as the incineration of hospital refuse is concerned.

Reader Enquiry Service No. **7593**

New Personal Toxic Gas Monitor

A small, battery-powered monitor to trace an individual's exposure to toxic gases throughout his working shift has just been introduced by Universal Environmental Instruments (U.E.I.), a division of J. & S. Sieger Ltd.—the gas detection specialists. The Miniature Continuous Monitor (M.C.M.) has been developed by U.E.I. in co-operation with MDA Scientific Inc., their distributor in the U.S.A.

The unit is the first personal monitor for the continuous recording of Toluene Di-isocyanate (T.D.I.) and Phosgene concentrations in a worker's "breathing zone" throughout a conventional eight-hour working shift. It provides vital quantitative information in clear graphic form from which may be determined an accurate time weighted average, the duration and extent of variations from ceiling value and a time/concentration exposure profile. The M.C.M. has both BASEEFA and American Bureau of Mines safety certification.

The M.C.M. operates on the basis of a stain produced on a slowly moving sensitised paper tape through which a metered sample is drawn. At the end of eight hours the tape is removed and wound through an optical reader linked to an X-Y recorder to provide easy to read graphic data.

While designed to be worn at chest level, the M.C.M. may be easily removed from its harness and placed in any desired plant location to measure ambient air concentrations or to study ventilation patterns·

The M.C.M. weighs 900 g, measures 159 × 57 × 105 mm and has Gas Detection Ranges of 0-0·8 ppm for T.D.I. and 0-0·4 ppm for Phosgene.

Reader Enquiry Service No. **7594**

CLEAN AIR

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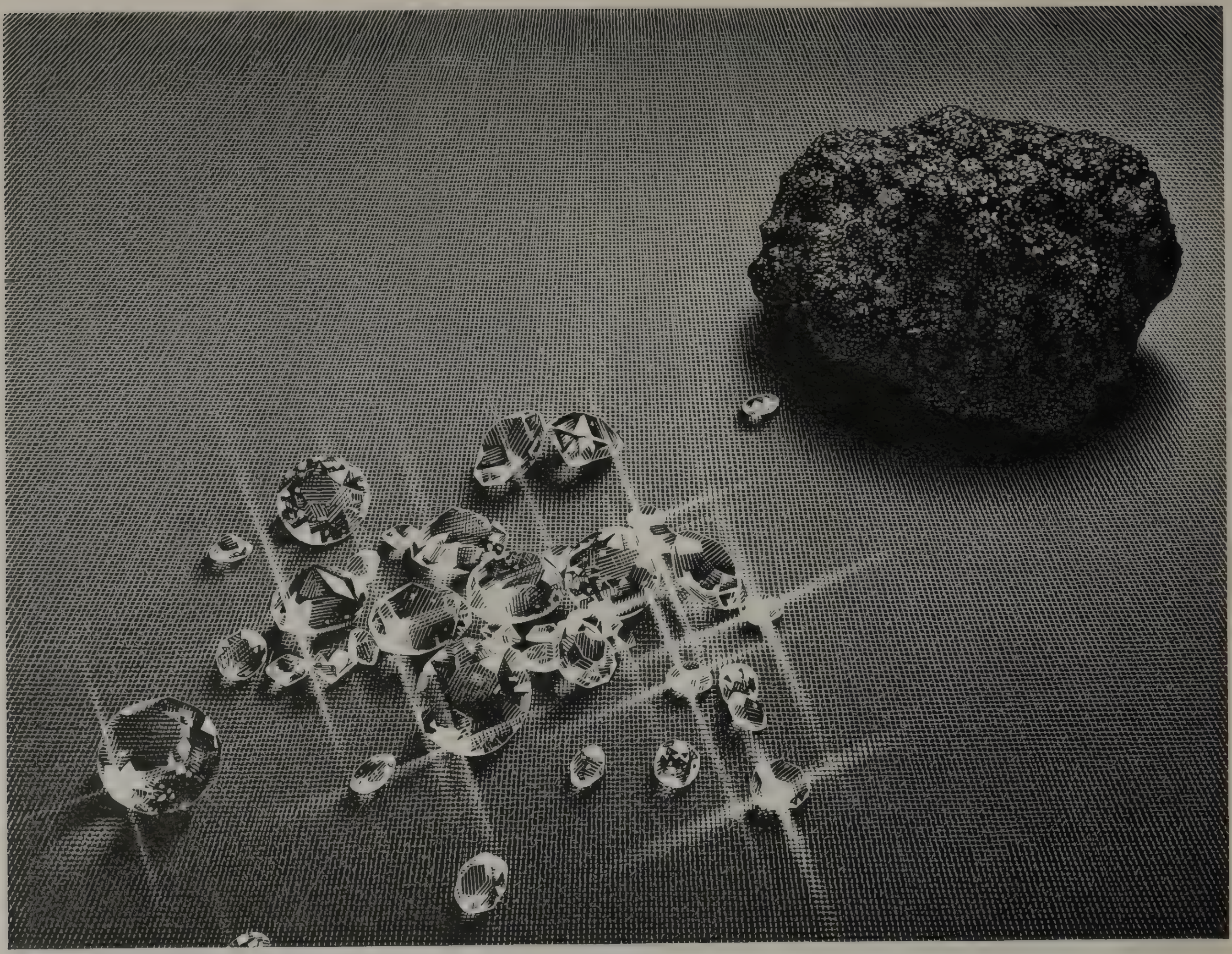

Coalite, like diamonds, is a form of carbon.
Coalite, like diamonds, is precious.

Carbon is a pretty surprising element. It turns up in some wild guises. Like diamonds. Men have killed for them. Women have succumbed for them. Fortunes have been founded on them.

Diamonds are precious.

Another of carbon's guises is known commercially as Coalite. That, too, is precious. That, too, has had a spectacular effect on people's lives. Coalite has helped to make towns and cities nicer places in which to live. Cleaner places. Happier places.

Coalite is coal with the tar oil and smoke-producing agents extracted. When Coalite burns it gives off all the good things: warmth, welcome, and a wonderfully old-fashioned glow. It does not give off the bad things: smoke and soot and sparks.

When the Clean Air Act was introduced there was a great move to Coalite. And it wasn't long before you could see the effect. The air became cleaner and fresher. The sky bluer.

In fact, when you burn Coalite, you're making ours a better country in which to live. And yours a warmer home.

Coalite
Fresh Air Fiends

Reader Enquiry Service No. **7596**

CLEAN AIR

WINTER 1975
VOL. 5 NO. 20

The Politics of Noxious Vapours
Lord Ashby, F.R.S.

Brighton Conference

Industrial News

Smoke Control Orders

Warren Spring Laboratory Open Days

International News

Book Reviews

Rehabilitation of Ironstone Workings
R. J. Cowan & R. Dean

Pollution Abstracts

Index to 'Clean Air'

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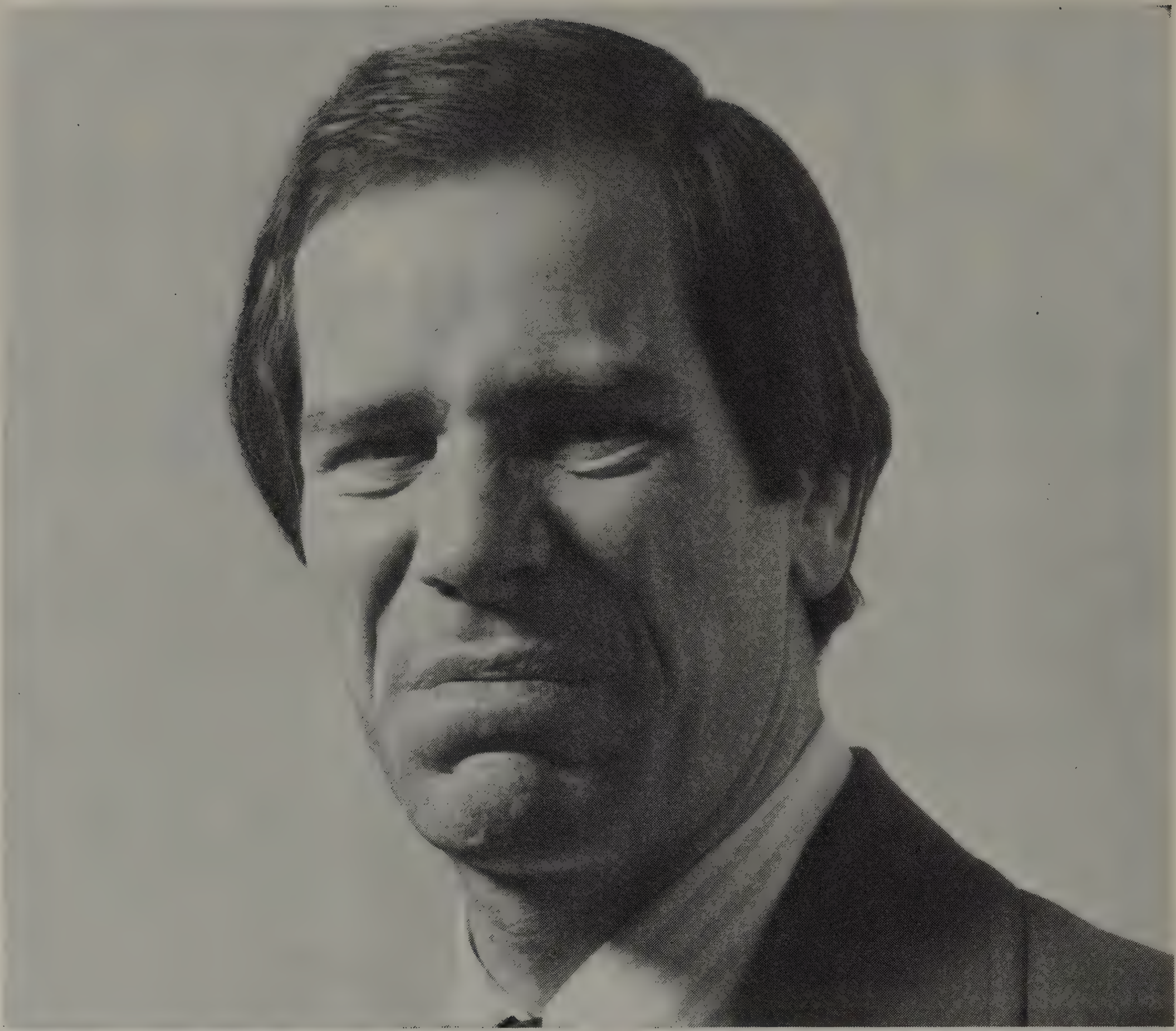

Health Inspectors who nose around some factories might regret it!

Visit some animal by-product factories, chemical plants or food processing factories and you would probably wish you hadn't! The smell which accompanies these manufacturing processes is a nuisance for those living in close proximity who can do nothing about it except complain.

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CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

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Diary of Events

14th January (Wednesday)
p.m. Conference & Publicity Committee Meeting
London

3rd February (Tuesday)
Yorkshire Divisional Meeting
British Steel Corporation's Templeborough Works

9th February (Monday)
East Midlands Division Council Meeting
Loughborough

18th February (Wednesday)
a.m. Technical Committee Meeting
London
p.m. Parliamentary & Local Government
Committee Meeting
London

26th February (Thursday)
p.m. General Purposes & Finance Committee
Meeting
London

9th-11th March
5th Clean Air Spring Seminar on "Odours"
Birmingham

24th March (Wednesday)
p.m. Conference & Publicity Committee Meeting
London

11th-15th October 1976
43rd Annual Clean Air Conference
Edinburgh

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CLEAN AIR

Financial Stringency

We are all aware of the economic difficulties with which the country is faced and in previous issues of this journal we have discussed the effect that this has had on clean air and on smoke control in particular. Indeed, in our last issue we unfortunately had to report that some local authorities had found it necessary to stop their smoke control programmes altogether, while others were slowing down the rate of progress very considerably. But the economic recession affects the Society more nearly than that. Like every industry, business and home, the Society has been severely hit by inflation and rising prices.

As a voluntary Society we are dependent on the subscriptions of our members as the main source of income and for the last two years we have been at pains not to increase these subscriptions. But the purchasing power of the income from subscriptions is now only about 75% of what it was two years ago and only recently there have been steep rises in the costs of postage, telephones, paper and printing, all of which have to be met if we are to continue as a worthwhile organisation. We, of course, augment our income by any profit that we are able to make on our conferences and seminars and this has been no small contribution in the past few years. Unfortunately, though, numbers attending our conferences have been reduced because authorities and organisations are reducing their expenditure on delegates' fees, the cost of travel and hotels. Consequently, our income from this source has also been reduced.

We are therefore placed in a position that to continue to function at the same rate, we need to increase our total income by some 25%. This could be done by increasing our rates of subscription, by about 25% all round, and by increasing the charges for our conferences by the same amount. The question then arises would our members be prepared to pay this higher rate of subscription? Would delegates pay a much higher fee to attend conferences? If we raised subscriptions would we lose members at the same time that we gained some income? In other words, would we lose on the swings what we might gain on the roundabouts? These are questions which the Council of the Society has to face within the next few weeks: but members may be assured that there will be no increases in subscriptions unless this is considered to be absolutely necessary. And, of course, if such an increase is proposed, members will have an opportunity of debating it at a General Meeting.

On the other hand, what we can already do is to reduce expenditure and this we are trying to do. The costs of providing members with Year Books and 'Clean Air' are not inconsiderable and the Council have therefore looked carefully at this part of our expenditure. You will certainly have noticed that 'Clean Air' now has a new appearance, and indeed some members have commented favourably on this. But it so happens that by adopting this new format, we have been able to save money on printing, and as the weight of the magazine is now less, we have also been able to save money on postage. In 1976 we shall go even further for the Council have decided that instead of a Year Book and four issues of 'Clean Air' in future we shall publish the Year Book and three issues of 'Clean Air'. The Year Book will be published on 1st January and 'Clean Air' will be published at the end of March, the end of June, and the end of September. This is an experiment for one year to start with but, if it is as successful as we hope, it will be continued. We shall be glad to hear from you, our members and readers, what you think at the end of the year.

It has been our custom in the past to send individually to each member and representative, notices of the Annual General Meeting and other important events. Most Divisions have sent similar individual notices of their Meetings to the members in their Division. Apart from the costs of printing and stationery, the cost of postage for such notices is now prohibitive. It is therefore intended to make much more use of this journal for advance notice of Society meetings and activities. We hope, therefore, that you will read carefully any such notices which appear and pay close attention to the Diary of Events as this may well be the only intimation that you will receive.

In short, we, like everyone else, are going through a difficult time. We are doing all we can to make savings without reducing standards but this is not easy, and there is a limit to how far we can go in this direction. We may, like many other organisations have had to do, have to raise our subscriptions. This will be done with reluctance and regret. But we hope and expect that if such a step is found to be necessary, we shall still enjoy the full support of *all* our members.

BRIGHTON CONFERENCE

This year the Conference returned to Brighton after a gap of 14 years. The weather was kind and Brighton looked its best in autumn sunshine. To celebrate the Society's 75th Anniversary it was decided that the Conference should have an international flavour and we were fortunate to be able to welcome speakers from Europe, from Japan and the U.S.A., and also some delegates from overseas. This meant inevitably that the papers presented had a rather wide view, some of which did not please some delegates; but air, especially polluted air, knows no boundaries, and we are a member of the E.E.C. It was important, therefore, that some of these far reaching issues should be debated, for it is perhaps not always realised that once an E.E.C. Directive is accepted, our own legislation will have to come into line, and the authorities concerned with the enforcement of such legislation will, in many cases, be local authorities.

The number of delegates who attended the Conference was a little disappointing; the economic state of the country —and of the world—unfortunately had its effect, and the fact that we are not alone in this experience, is of little consolation. Nevertheless, most people who attended the Conference derived some benefit from it and, we hope, learned something new.

The Opening Session took place in the Dome on Monday evening, the 20th October. The Mayor of Brighton, Councillor William Clarke, extended a warm welcome to those present and hoped that visitors would take advantage of all that Brighton had to offer, including the invigorating sea air. Mr. B. Shindo, President of the International Union of Air Pollution Prevention Associations, Tokyo, who was to have made the Opening Address, was unfortunately unable to attend but we were very pleased that Professor Kiyoshige Shiozawa, Managing Director of the Japanese Union of Air Pollution Prevention Associations was able to be with us and take Mr. Shindo's place. Professor Shiozawa delivered a very kind opening address and, throughout the Conference, was keen to spread the word about the 4th International Clean Air Congress to take place in Tokyo in May 1977.

Professor P. J. Lawther then gave the Presidential Address in his own fascinating and inimitable manner and whetted the appetites of all present for what was to follow that week.

The theme for the two Sessions on Tuesday was 'International Attitudes to the Control of Pollution'. The first paper, by Dr. L. E. Reed and Dr. M. T. Westaway, looked at different Air Pollution Control Procedures employed by various countries. Mr. M. L. Tunnicliffe, H.M. Deputy Chief Alkali and Clean Air Inspector, presented 'The U.K. Approach and its Application by Central Government', and Mr. T. H. Iddison's paper covered the Local Government Approach and Application. The E.E.C. Approach was expounded by Mr. S. Johnson and Dr. W. Hunter (co-author with Dr. P. Recht and Dr. J. Smeets), and Dr. L. A. Clarenburg of the Rijnmond Authority of the Netherlands spoke on a new approach to standards. That there were very differing views about the various approaches was very clear, and this was apparent in the trenchant manner in which Professor Lawther opened the discussion.

The Mayor, Professor Lawther and Professor Shiozawa at the Opening Session

Two papers were presented under Wednesday's theme of 'Conservation of Resources', the first by Professor C. E. Barthel Jr. of Miami University, U.S.A., and the other by Professor F. Roberts from Brunel University.

On Thursday morning, three papers were presented on the 'Technical Aspects of the Control of Industrial Pollution'. Gases from industrial installations were discussed by Mons. J. P. Detrie from France; purification of industrial effluents was covered by Dr. F. Malz from West Germany; and Mr. R. A. Fish, from the G.L.C. Scientific Branch, dealt with toxic and other hazardous wastes.

Energy from the Continental Shelf was the title of Thursday afternoon's Session. Mr. J. M. Bowen of Shell Exploration and Production Ltd. spoke of the search for oil and the techniques employed; Mr. F. G. Larminie of B.P. Ltd. explained how the oil was produced and the measures taken to prevent pollution; and Mr. H. B. Greenborough, the Chief Executive and Managing Director of Shell Mex and B.P. Ltd. ably put North Sea oil into its proper context and perspective.

Friday morning saw the last three papers on the subject of 'Pollution from Road Vehicles'. 'One Man's Car—Another Man's Poison?' by Dr. S. Reed of the G.L.C. Scientific Branch was provoking to say the least. Mr. P. S. Gray from Brussels explained 'The E.E.C. Philosophy of Control', and Mr. David Collins of Ricardos brought everyone down to earth by stating quite clearly what was possible

Abstracts of all the papers presented begin on page 28 of this journal.

On Wednesday afternoon everyone had the chance to take advantage of the fine weather and visit some of the places of interest around Sussex. Some delegates went no further than Brighton Racecourse. No horses were around that afternoon but there were several Enfield 8000 electric 'city' cars which Seeboard are testing as part of an Electricity Council Project.

The Enfield 8000 is an aluminium bodied two-seater, powered by eight 12-volt lead-acid batteries of 92 Ah capacity at the 5-hour rate, connected in parallel pairs to give a maximum of 48 volts with a top speed of 40 mph, its range is expected to be up to 55 miles depending upon traffic conditions and how the car is driven. A built-in battery charger enables the 48-volt battery to be fully charged in eight hours from a standard domestic 13A socket outlet. Visitors could test-drive the cars if they wished and most did so. We owe our thanks to Seeboard for this very interesting demonstration.

Other parties of delegates and their wives went on visits to the Roman Palace at Fishbourne, Petworth House, and the Bluebell Railway.

On Tuesday morning Country Casuals Ltd. presented a fashion show for ladies in the Pavilion Theatre, and on Thursday morning the ladies visited Preston Manor and Brighton Corporation's Nursery Gardens at Stanmer.

For the second time a Northern Irishman won the Solid Smokeless Fuels Federation Golf Cup in the N.S.C.A. Golf Competition. On this occasion it was Mr. Brian Blaikie, the Senior Public Health Inspector from Bangor, Co. Down. Mr. Blaikie's success was applauded by all the other golfers as he had the lowest handicap (2) of all the players, his score of 35 points was excellent over the very demanding Dyke course in Brighton. Second was Mr. W. Meredith, Chief Environmental Health Officer, City of Portsmouth with 34 points who beat Mr. A. T. Morgan, the Pollution Officer, Trafford Borough Council on the back nine holes. 21 Players took part and enjoyed a wonderful afternoon with very good weather over a course in first class condition. It is hoped that there will be a similar turnout next year in Scotland.

Part of the audience at the Tuesday morning session

Dr. F. Maiz on the Thursday

It was a pity that so few turned out at the Preston Park Tennis Courts, Brighton, particularly as the weather was so fine on the Wednesday afternoon. Nonetheless, it was a pleasant afternoon's tennis for those who did, although the small number of participants meant that the Cup, generously donated by the Gas Corporation two years ago, was not presented. Delegates are reminded that the main intention of the Tournament is to have an enjoyable afternoon's sport and those who fear that the standard is going to be too high may be assured that this is not so. Each year the host Authority makes the facilities available to delegates and I hope that next year we shall see more people coming to the Conference armed with their tennis rackets.

Special arrangements were made at the Brighton Sports Centre for a few delegates to play squash and this, too, proved most enjoyable.

The facilities of the Corn Exchange were put to good use by a number of companies who exhibited their products. British Petroleum showed how North Sea oil affects us all and this excellent display supplemented Thursday afternoon's Session at the Conference. Plastic Constructions Ltd. from Birmingham exhibited a complete working scrubber, and the Central Electricity Generating Board showed graphically how electricity is produced.

International Gas Apparatus (Camberley) showed many of their products as did Carboeglen Ltd. (Thame), Charles Austen Pumps Ltd. (Byfleet), Nailsea Engineering Co. Ltd. (Blackburn) and Analysis Automation Ltd. (Oxford).

Twelve films about pollution and its control were shown in the Pavilion Theatre throughout the week. This was a new feature of the Conference which proved popular, and it is hoped to repeat it in future years. It was most unfortunate that one of the films shown was out of date and gave a wrong impression of pollution in one part of the country, and we apologise deeply for this.

In addition to the events already described there was, of of course, a social programme. The President gave a small dinner on the Monday evening; on Tuesday evening the Chairman of the Society's Council gave a reception in the Banqueting Hall at the Royal Pavilion and on Thursday the members of the Council of the Society were entertained to a Civic Lunch. That evening the Royal Pavilion was again the venue for a Civic Reception and Dance given by the Mayor and Mayoress and the Corporation of Brighton. Guests had the opportunity to view many of the beautiful rooms opened for such occasions, including the Music Room, then still in perfect condition, but now, sadly, much damaged by fire.

It was a full week, and generally a fruitful one. The programme did not please everybody; it never does. To cater for all tastes is never easy. Some people are pleased one year and others are disappointed. The next year, with a programme with a different slant, the position is reversed. The programme of papers and discussion at Edinburgh in October 1976 will be to everyone's taste. We will certainly try to ensure that it is.

Professor Shiozawa, Dr. Clarenburg and Professor Barthel at the Chairman's Reception.

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The Politics of Noxious Vapours

by

Lord Ashby F.R.S.

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In these troubled times a public lecture such as this one should have some relevance to our present perplexities. One of these perplexities is how to make political decisions which require an understanding of science and technology. Anyone who has had to make political decisions (by this I mean decisions on behalf of society; I am not talking about party politics) knows that "hard data" constitute only one of the inputs for decision-making. Another equally important input is the value which society places upon the decision. The integration of these two inputs—quantitative facts on one hand and social values on the other—into a policy-decision is sometimes very difficult. It is not at all unusual for the social values to be given greater weight than the quantitative facts. One recent example is the siting of a power station near Nottingham. The cost-benefit analysis indicated that the optimum site for the power station would be at a place called Holme Pierrepont. But the conservation lobby protested on the ground that it was in Nottingham's green belt. The protest led to a public inquiry. If the power station had to be built on a site acceptable to the conservationists it would cost (so it was claimed) an additional £600,000 a year to run. The conservationists won: the power station is not built at Holme Pierrepont. The subjective value attached to amenity outweighed the objective, measurable, facts.

It is obviously very important to understand how political decisions are made which have to reconcile scientific knowledge with social values. This is particularly true of decisions which project themselves into the future: policies about nuclear power, genetic engineering, and—the most familiar example—the environment. The consequences of political decisions on these issues stretch far beyond the lifetime of parliaments and city councils; or, for that matter, far beyond the lifetime of MPs and city councillors. Already new patterns of politics are emerging to deal with such issues. (Who, for instance, thirty years ago, would have predicted that Britain would have a Department of the Environment and America an Environmental Protection Agency, both with quite formidable powers?) To understand how these new patterns are evolving we have to see them in the context of history. For a century and a half, at least, parliament has made spasmodic attempts to legislate for a better environment. Many of the attempts failed. It is instructive to diagnose the causes of failure; but in this lecture I want to interest you in a case-history of success, for it illustrates how Britain has, almost by accident, hit upon a promising, though still rudimentary, technique for handling, at any rate some, political problems involving science and social values. So let me plunge straight away into my theme. It is to examine the interplay of social values, scientific knowledge, legislation, and administration, upon the control of "noxious vapours": in brief, the parts which were played by the man-in-the-street, the scientist, the Member of Parliament, and the civil servant, to produce the undoubtedly cleaner air over Britain today.

A theme, you will agree, appropriate for Sheffield. For a century and a half this city lived under a pall of smoke; it can now claim to be the cleanest industrial city in Britain. Lord Palmerston gave the city its first smoke legislation in 1853. But neither public opinion nor the state of technology at the time was adequate to bring much benefit from the act. The dramatic improvement dates only from the Clean Air Act of 1956. Since then the average smoke concentration in winter has fallen to one-sixth of its normal pre-1956 value.(1)

Why has this happened? Or, to put the question another way, why did it not happen 50 or 100 years ago? The short answer is not only that the technology of smoke control is now adequate, but also that ordinary people now expect air to be clean and free from noxious vapours.

Why do people now expect air to be clean? It is a question of priorities. There is a true story of a lawsuit in the Harlem district of New York, which serves as a text for my theme. A church brought an action against a fishglue factory because the offensive smell from the factory was causing distress to the church and, it was alleged, was disrupting its activities. The lawyer defending the fishglue factory was cross-examining a black woman. "If the smell is so bad," he asked, "why do you continue to go to that church?" Whereupon the woman turned to the judge and said: "Mr Judge, the worst stink that ever was stank wouldn't keep me from my Lord Jesus." The church lost the case.

It is, you see, a question of priorities. As other social needs are satisfied, the abatement of pollution rises in the hierarchy of social values. Today there are votes in clean air, in sewage, in conservation. There is vivid evidence of this public interest in statistics from this city. In a recent paper(2) there is a diagram which shows how the dirt deposited in Attercliffe between 1955 and 1970, fell from about 250 to about 150 mg/m^2 per day. But over the same period the number of complaints to the Public Health Department about dirt rose from about 100 to nearly 300! There are, as the last report of the Alkali Inspectorate put it, "ever more stringent requirements of the public for cleaner air".(3) This is true also elsewhere. In a recent opinion survey in the State of Washington some 3000 people were asked to put, in an order of priority, the social improvements for which they would be prepared to pay higher taxes. This, of course, was nothing more than a measure of their self-interest. Crime prevention came top in the list, but pollution control was second. Health care was sixth, the poverty programme eighth, defence eleventh, and foreign aid at the bottom of the list. A middle-class response, no doubt. But in America the middle class elects the Congress. As social values rise, social norms rise too. Clean air is becoming something one has a right to expect, a social norm, just as it is now a social norm to expect an indoor toilet and bathroom in the home for each family.

This rise in values and norms is not spontaneous; indeed it is often a delayed response to the propaganda of pioneers in social reform, who campaign for higher standards, sometimes against massive inertia from the public. It is the product of a complex chain of events. Nor is it the end-product of this chain: it leads ultimately to legislation, which can be regarded as a symbol of the national acceptance of social norms. Thus the comprehensive Control of Pollution Act, passed without controversy in July 1974, embodies in statute the values which are now attached to a clean environment. The complex chain of events is a long one. There are many links—and often many years—between the stimulus and the response. I shall now take you along the chain for one particular component of Britain's environment, namely, noxious vapours.

The Alkali Act of 1863

On 9th May 1862 Lord Derby moved in Parliament for a select committee "to inquire into the Injury resulting from noxious Vapours evolved in certain manufacturing Processes, and into the State of the Law relating thereto".(4) It was a somewhat apologetic speech made (as he said) "in the absence of more exciting topics for discussion". He commended the high birth rate and the vigorous industrial growth of Britain and added: "no man would be insane enough to suggest any measure which would be likely to result in placing the slightest check in the way of these two great elements of our national prosperity". He then went on to describe the appalling destruction of vegetation which had been going on for years around the alkali works in St Helens, Newcastle, and Glasgow. *The Times*, commenting on Lord Derby's speech, disclosed something unfamiliar to most of their readers: "Whole tracts of country, once as fertile as the fields of Devonshire, have been swept by deadly blights till they are as barren as the shores of the Dead Sea".(5) Not only were trees destroyed and crops ruined. "Metal objects . . . window fittings, locks . . . wasted away at an alarming rate. Tools of mechanics were rapidly blunted and window curtains are said to have been destroyed almost as soon as they were hung."(6)

It was not only those whom Lord Derby described as "the poor tenantry and cottagers" who suffered. Lord Derby's own estate, and those of other landed gentry in the neighbourhood of St Helens had deteriorated in value to the tune, he said, of £200,000. Even so, he would not, he said, have contemplated legislation which might interfere with such an important industry were it not for the fact that there was an easy and inexpensive remedy "admitted by the manufacturers themselves".

The blight was hydrochloric acid (called, in those days, muriatic acid) and the remedy was to dissolve it in water by washing the fumes in coke towers. Indeed a few manufacturers had been doing this for over twenty years(7) but the majority, despite the evident damage they were causing, were letting the acid escape with impunity. For the only recourse to law was to sue for nuisance, and it had to be proved that the particular works being sued was the one responsible for the damage. This was extremely difficult and although damages were sometimes awarded, actions for nuisance were notoriously frustrating; indeed, the very culprits were liable to be sitting on the bench as magistrates.

The Select Committee under Lord Derby's chairmanship was appointed in May 1862 and it reported in August. The issue was not in fact very controversial. The alkali manufacturers were tired of being badgered by complaints. They did not dispute that there was a simple remedy, and the majority of them (they emphasised that it was only a majority) were prepared to apply the remedy provided all their competitors were obliged to do the same.

This was the origin of the Alkali Act of 1863. It applied only to this one industry and only to the control of one pollutant—hydrochloric acid; and it was drafted in such a way as to minimise inconvenience to trade. All the same, it was the overture to the enlistment of technology in politics, for it empowered inspectors to have free acess to alkali works "at all times . . . with or without notice" and to enforce the condensation of acid vapours.

Of course this was not the first example of state intervention in industry. Since 1833 the Factory Act had empowered inspectors to enter premises of certain specified industries, but only to control the hours of work of women and children; and even that had been regarded by some employers as an unwarranted intervention in their private affairs. The Alkali Act carried intervention a stage farther; for the alkali inspectors were appointed to prevent a profitable private trade from being a public nuisance.

Notice three features about the story so far. First, an accepted social norm was challenged. For years the destruction of vegetation had been accepted, not of course without protest, as the inevitable price to be paid for industrial progress. Then a point was reached when it became intolerable that an alkali works, however profitable, should devastate a countryside, especially when the devastation included property belonging to members of the House of Lords. Even this conclusion, however, was not reached without reservations; Lord Stanley, moving the second reading of the Bill, said, of the alkali industry:

> "If, in its earlier stages it had been subject to a system of inspection, and constant interference had taken place with its chemical experiments . . . it would have been so paralysed that it never would have arrived at the position in which it stood at present,"

He summarised the position: the annual value of the product was £2·5 million; 19,000 persons were employed; and the annual wage bill was over £870,000. And he then went on:

> "Their Lordships would therefore regret if any legislation with a view to enable owners of land to recover damages from the manufacturers with greater facility than at present, should be attended with injury to so important an interest."(8)

The second feature about the story is that the necessary technology for meeting the challenge was at hand. Other noxious vapours were polluting the air, but hydrochloric acid was the only one which could easily be removed; so no legislation was proposed about the others. Third, the law did not *prohibit* the nuisance, it *controlled* it; for it required only that 95% of the acid vapour should be removed. This is typical of the pragmatism which, to its benefit, permeates technological legislation in Britain. Its very reasonableness made it more acceptable and possible to police; and, most important, it made the law politically possible. Prohibition would not have been politically possible.

There are other interesting features of the legislation. On the advice of Lyon Playfair (who was a witness before the Select Committee) the Act did not prescribe how the vapour was to be condensed, for, as he put it, "To define a plan might stop invention". So it was left to manufacturers to find the best way to comply with the standard. Another feature was the emphasis on an inspectorate attached to central, not local government; "removed, as far as possible, from all local influence". The natural pattern would have been to put responsibility on the local authorities; the advantages of a centralised inspectorate were twofold; one, that uniform standards of enforcement could be applied all over the country—an improved technique for abating the vapours in, say, Lancashire, could be urged upon the manufacturers in Newcastle; and two, that inspectors would not be employees of the local authority, which often comprised the owners or managers of alkali works.

The first Alkali Inspector

I said that the chain of events which change social norms is a complex one. One of the complexities is that there is sometimes a feedback from the end product: laws passed to enact social reform, even if they do not fulfil the hopes of the reformers, do raise expectations among the public; they may exert a powerful pedagogic function. This was certainly true of the Alkali Act, and the pedagogue was the first alkali inspector, Angus Smith. His duty was a narrow one: to ensure that not more than 5% of hydrochloric acid escaped from alkali works; but he took a much broader view of his function than that. His annual reports, though deplorably long-winded and probably not widely read, set the style for pollution control in Britain. "Beginning as I did," he wrote in 1864, "with a strong desire to aid the public in the way most agreeable to the manufacturer, I could not forget that it was in his power to . . . make the office of inspector most difficult and disagreeable".(9) Wisely he soft-pedalled on prosecutions (and was criticised for it, as his successors are today) and used, instead, "advice and friendly admonition". His diplomacy succeeded. His data on overall emissions are not (I suspect) fully trustworthy; but they indicate the order of magnitude of his achievement. Even in the first year the emissions of hydrochloric acid were reduced from something like 1000 tons a week to 43 tons.(10) But Smith soon ran up against the deficiencies of the Alkali Act. All sorts of other noxious vapours were polluting the air and Smith was powerless to do anything about them; his jurisdiction was solely over hydrochloric acid, and—even for that acid—only from alkali works. This led to exasperating incidents. An action was brought by a Mr. Powell against Messrs. Chance for damage from acid vapours. To Smith's dismay he found no escape of hydrochloric acid. The vapour was sulphuric acid, which was not covered by the Act. So Mr. Powell lost his case; and Smith, anxious to keep within the law, wrote:

> ". . . It is not for myself and colleagues to become general accusers, and we do not think it proper to point out the offence even when it is known to us, unless we find muriatic acid."(11)

Even to quantify the statutory limit had its drawbacks. It protected the manufacturer from "mischievous" litigation, but, as Smith went on to say:

> "A strange result, therefore, takes place; we become defenders of the alkali works, and appear also to defend the right of sending out 5% of the gas; whereas the case is merely this; we cannot publicly object until that amount is attained."

Here Smith was up against a controversy in the politics of noxious vapours which is still going on: Should emission standards be fixed in this way at all? The Americans and some continental countries favour statutory emission standards. One objection to them is that there is no obligation on the manufacturer to improve on the standard. Although by good technique a great deal more than 95% of acid could be condensed, the law, as it stood, was a licence to discharge 5% of the acid. This irked Smith considerably.

By the time he came to write his eighth report, Smith was clamouring for a revision of the Act. He had realised that it was better to control the concentration of acid in the emission than simply to reduce the percentage, and he advocated a standard of not more than 0·2 grain/ft^3. He had by persuasion in fact already achieved that standard, and he found that alkali works now were discharging greater concentrations of sulphuric and sulphurous acids than of hydrochloric acid; but these discharges were immune from official comment, let alone legal control. The averages he published for the year 1871 were (in grains/ft^3 of smoke); hydrochloric acid, 0·1624, sulphuric acid, 0·3800, sulphurous acid, 0·4800.(12)

In 1873 the Inspectorate was transferred from the Board of Trade to the newly established Local Government Board; and Whitehall at last took Smith's advice; at any rate a little of it. A fresh Act was passed in 1874. It did not bring other industries under his surveillance except the wet copper process. But it did replace the 5% tolerance for hydrochloric acid with a statutory limit of 0·2 grain/ft^3 (which is still the limit today); and it gave him power to test for other noxious gases, but only from alkali and copper works. The most significant addition turned out to be one which, at the time, must have appeared trivial. It was to require the alkali makers to use the "best practicable means" to prevent the escape of other noxious gases (a phrase which had stood, unnoticed, for a generation or more in local improvement acts). Why is this phrase significant? Because, as Smith's successor wrote in the 24th Report of the Inspectorate, the injunction to use the best practicable means:

> ". . . would prove an elastic band ever tightening as chemical science advanced and placed greater facilities in the hands of the manufacturer. When necessary, it could be shown that this phrase would give greater security to the public than would the adoption of any fixed standards . . ."(13)

Smith's achievement after 10 years as alkali inspector was remarkable, but he failed to get the credit he deserved, for as the abatement from each works improved, the number of works multiplied—production doubled between 1862 and 1876(14)—and his annual reports carried rueful calculations to show how the 5% of acid immune from his control, multiplied by the increasing number of new works (not to mention other noxious vapours outside the Act) were still sufficient to damage vegetation. "It was not our duty," he protested, "to cause crops to grow, it was our duty to cause the works under our charge to send out not more than 5% of muriatic acid".(15) His efforts may not have restored the vegetation around alkali works (opinions differ over this) but they were achieving something more important: they were helping to create (though Smith himself did not realise this) a change in social values about noxious vapours. With the rapid growth of a chemical industry noxious vapours were increasing. In the 1850s they might have been accepted as inevitable concomitants of affluence. By the 1870s the efficacy of legislation to control hydrochloric acid (and, to some degree, smoke also) was becoming generally known and this provoked pressure for more stringent control. In his annual reports Smith called attention to some of the uncontrolled noxious vapours; chlorine, sulphuretted hydrogen, acids from oxides of sulphur and nitrogen; and he threw out a suggestion which seems very topical, namely that industries whose acid emissions damage property should pay for the damage on a scale depending on the amount of acid discharged and the distance from the damage—an early plea for what economists call "internalising the externalities", or the "polluter-pays-principle".

The Royal Commission on Noxious Vapours

The stiff wheels of Victorian democracy began to turn. In those days there were no mass media to give instant visibility to environmental crises. National newspapers had a very meagre circulation and the sensational techniques of the modern popular press were unknown. The tool to stimulate political action was the organised pressure group such as the Health of Towns Association, which had existed since 1844. To mobilise their discontent over the deficiencies of the Alkali Acts, some victims of noxious vapours banded themselves together as the "Lancashire and Cheshire Association for Controlling the Escape of Noxious Vapours and Fluids from Manufacturers". This body, together with others, stimulated a petition to the House of Lords, asking for a comprehensive review of the law.(16) Simultaneously the bureaucracy itself became convinced that the powers of the inspectors should be extended to other chemical works. The permanent secretary of the Local Government Board, John Lambert, advised his Minister that the time had come to bring in a new bill, and, incidentally, to increase the salaries of the sub-inspectors by £100 p.a.(17)

The House of Lords responded, and petitioned the Queen (who herself had complained that ammonia from a cement works near Osborne was making the royal estate uninhabitable)(18) for a Royal Commission. It was duly appointed, under the chairmanship of Lord Aberdare, and it included two distinguished chemists, both Fellows of the Royal Society: Alexander Williamson, professor at University College, London, and Henry Roscoe, professor at the Owens College, Manchester. The terms of reference authorised the Commissioners to inquire into any noxious vapours they cared to include, from any kind of factory. It was a sign of the state of public expectation that the Commissioners took a great deal of trouble over their job, visiting all sorts of works in SE, NE, and NW England and in Wales.

The Commissioners were confronted by two questions which still trouble those who have to legislate for the environment. First, there was no convincing evidence that noxious vapours harmed human health; how far should parliament go in constraining a profitable industry "merely" (I put the word in quotes) to preserve the health of trees and crops and to legislate against what may be little more than a nasty smell or dirty smoke? Second, there were some evident nuisances for which there was, at that time, no technology for abatement. The only effective way to stop them would be to shut down the works. Should these nuisances simply be tolerated, not suppressed? One of the worst—and it is still a nuisance—was dust from cement works on the Thames estuary. Listen to the evidence of Mr. Vulliamy, resident at Greenhithe, who kept a record of his tribulations from cement works: "Instead of . . . being able to walk about in one's garden, and play croquet with the ladies, we were obliged to go in and shut the doors and windows."(19) But citizens differ in their order of priorities. If Parliament legislates to facilitate Mr. Vulliamy's croquet matches, would this affect workers in the cement factory? Mr. Vulliamy himself gave the reply. "When you threaten proceedings," he told the Commission, "they [the cement workers] mob you, blackguard you, and throw stones at your carriage . . ."(20) And a partner from the cement works, when confronted with the complaint, retorted that Mr. Vulliamy's nerves must be so sensitive that "perhaps eau de Cologne would give him a headache".(21)

Other vapours were destroying more than amenity. The Archbishop of Canterbury caused a stir by complaining publicly about deterioration of the stonework at Lambeth Palace, and the discoloration to his knives and forks. "There is not a figure that has got a nose on it" declared the rector of Lambeth, "or, if it has, at a touch it will drop off."(22) The culprit for producing what was called "Lambeth fog" was thought to be Doulton's potteries. Henry Doulton appeared personally before the Commission. "Our operations are quite innocuous," he said, and he warned that it would be a serious matter "to interfere with a trade which gives employment to a thousand families, and which has existed for centuries."

"I suppose," asked Lord Aberdare, "it is the fact that people, as civilisation advances, get more sensitive to evil smells?" Exactly so. And this was the political problem before the Commission. What price should be paid for amenity? For there was no case for suppressing the nuisance as a health hazard; indeed the Medical Officer of Health for St Helens, the region worst affected by noxious vapours, went so far as to suggest, with supporting data, that the vapours "medicated" the air (as he put it) and protected the town from some diseases. To control noxious vapours was not, on the evidence before the Commissioners, a matter of life and death. The issue was nothing like so clear as it had been for the Factory Acts, where it was obvious that the conditions of work were damaging the health of the workers. So the problem was how to strike a balance between on one side the benefits to employees and to the nation from these polluting trades, and on the other side the inconvenience and damage to property and vegetation which the trades caused. This is a political, not a scientific or economic problem.

One approach to the political problem is to issue comprehensive, proscriptive decrees. This was the course taken by Napoleon, as long ago as 1810(23) in his inimitably succinct (and in the long run ineffective) way.

"Manufactures which give out an unwholesome or unpleasant odour will not be allowed to be established without the authority of the Administration." The decree then went on to put a long list of manufactures, some 14 pages of them, into three classes: those which must be distant from all private dwellings; those which must not adjoin private dwellings unless they can be carried on without damage or inconvenience to the neighbourhood; and those which may remain without inconvenience near private dwellings. In 1867, when Angus Smith examined this typically elegant but impotent Gallic law, he concluded: ". . . comparing the attempts to legislate with the result, there has been in all cases a failure of the most decided kind. The so-called preventive system has failed".(24)

The British approach to air pollution was, by contrast, tentative—not to say reluctant—untidy, and piecemeal, but refreshingly realistic. For eleven years the inspectors were debarred from noticing any emission except hydrochloric acid from any factory except an alkali works, for the sufficient reason that there seemed to be no adequate techniques for other kinds of abatement. The legislation which followed Lord Aberdare's Royal Commission widened the inspectors' powers; but only marginally. The Alkali, etc. Works Regulation Act, 1881, reaffirmed the fixed standard (0·2 grain/ft^3) for hydrochloric acid and added two more fixed standards, not more than one grain of sulphur or half a grain of nitrogen for acids composed of sulphur or nitrogen. It also expanded the list of processes to be registered by a dozen or more. All noxious vapours from these—other than the three for which statutory limits were prescribed—were to be controlled by the "best practical means". Over cement works, the legislators were perplexed, and their decision exemplified the British style in the politics of noxious vapours. It was recognised that the emissions of dust were a grave nuisance but there seemed at that time no agreed practicable means to control the nuisance. So the law gave the Local Government Board power to extend its jurisdiction over cement works once effective means of control had been discovered. An effective means did not materialise until 1935, when the technique of electrostatic precipitation came on the market. It was also significant that the word "etc" appeared in the Act; for this was a declaration of intent: that as the science and technology of pollution abatement progressed, the scope of the Act would widen.

Legislation which was tentative, untidy, and piecemeal! But it worked, while definitive, tidy, and comprehensive legislation on the continent did not work. The strength of the law was that it was coupled with administrative machinery to enforce it and it never promised more than the inspectors could reasonably perform. The weakness of the law was inseparable from its strength: because it was realistic, it also appeared too indecisive, too modest, too indulgent to industry.

Political Decisions and the Inspectorate

Since 1881 there have been two further revisions of the Act and numerous Orders extending the scope of the Inspectorate to new processes; it now controls 3000 of them. But the 1881 Act still remains the pattern for the politics of noxious vapours. Five features of this policy are worth noting. First, measures for control are firmly tied to the capacity of science and technology to make them effective at reasonable cost—thus the Act could be tough about hydrochloric acid but, and this is still the case, it would be unrealistic to be equally tough about sulphur dioxide. Second, the policy is not one of prevention (unless, of course, the gases are poisonous); it is one of abatement. Third, the policy, though it was laid down before the principles of welfare economics were elaborated, did recognise that the cost of abating pollution may exceed the cost of the damage done by pollution. There was and still is in the minds of the Alkali Inspectorate, the realisation that to eliminate some nuisance completely would involve a net loss to society and not a net gain. The Aberdare Commission put it this way: "Those means of improvement cannot be called practicable which involve a ruinous expenditure." Fourth, the policy has been, and still is, flexible. The best practicable means is, as I quoted, "an elastic band ever tightening" the techniques of abatement. It is still true, as it was in Smith's time, that a newly built works has to incorporate the most up-to-date equipment for pollution control, while an obsolete works, making the same product, may be permitted to run for its limited life on a poorer standard of pollution abatement.

The fifth feature is the style of administration of the Act. A policy as flexible as this would not work if the inspectors were incompetent, or susceptible to pressures from industry, or corrupt. Nor would it work if the inspectors behaved like a crime squad, zealously seeking culprits. The policy has worked reasonably well in the public interest, due to the integrity and expertise of the inspectors and the tradition, going back to Angus Smith, of securing the confidence and co-operation of the industrialists whose works are open to inspection. Of course, this lays the Inspectorate open to the charge that it is acting in the interests of manufacturers and not of the public, condoning infractions of the law; suffering (as one MP put it) "from the sin of insipidity". The Inspectorate's reticence, and its occasional twitches of querulous defensiveness, make it an easy prey for critics. Thus a team organised by a body called Social Audit published in 1974 a special report on the Alkali Inspectorate, which is in places severely critical, not of the Inspectorate's staff but of its policies.(25) Some of the criticism is valid, some of it misconceived. But all of it illuminates the politics of noxious vapours; so let me spend a few moments on one misconceived, and one valid, criticism.

The misconception—and Angus Smith is partly responsible for it—is that the sole duty of the inspector is to minimise pollution. You recollect Smith's frequent protestation: "My job is simply to cut down the emission of muriatic acid by 95%." Once the phrase "best practicable means" was introduced, this was no longer true; for the interpretation of "practicable" is (to quote one of the Acts) "having regard amongst other things, to local conditions and circumstances, to the financial implications and to the current state of technical knowledge." Every decision of the inspector has to take into account the state of the art, the finances of the firm, the morale of the operatives and the effect on their employment, the national need for the product. and the amenity of the public. This is not a mere technological decision; it is a political one. Of course some such decisions are bound to be wrong; but to assume that the alkali inspector's job is simply to keep noxious vapours out of the air, to minimise pollution at any price, is entirely to misunderstand his function. He has to *optimise* pollution, which is philosophically and politically a far more subtle task. So when the Social Audit team asks: "Whose interests are served?" and concludes that it is not primarily the interests of the public, they are assuming that the law exists only to protect the public from noxious vapours. It does not: it exists to reconcile the (often) conflicting interests of the public who want clean air, the manufacturer who wants to make a profit, the employees who want to keep their jobs, and the government who want national prosperity and contented citizens.

It is arising out of this that Social Audit has a valid criticism. The Alkali Inspectorate repeatedly emphasise that they work by educating the manufacturer, not threatening him. (It was Angus Smith who resisted the pressure to teach "by the cane instead of through the intellect". (26) Their achievement in educating the manufacturer is indisputable. But they act also in the interests of the public and there is an educational duty toward them, too. It would be unreasonable to expect the Alkali Inspectorate, with its minuscule staff (only 36 for the whole of England and Wales) to take on this task. But someone must take it on, for there is a growing disenchantment with all technocratic services, not only the alkali inspectors. The public now demand to know facts about the environment, as they long ago demanded to know the facts about industrial health and national finance. Some bureaucrats resist this demand, saying: "What good will it do them, to know the amount of sulphur coming out of the local power station? They won't understand what it means." My reply is that it may not do the public much good but it will do the alkali inspectors and the Central Electricity Generating Board a lot of good, for it will lift the fog of quite unnecessary secrecy surrounding their operations. The facts will doubtless be misinterpreted, perhaps misused. But in the democracy of the 1970s this risk must be run (we run it every time we publish the monthly trade figures). To run this risk is less objectionable than to withhold information from the public.

The Alkali Inspectorate already publish in their annual reports a good deal of information about their activities, but not the sort of information which interested members of the public think they have the right to know, namely how much dust a specific cement works, or how much sulphur dioxide a specific power station, or how much fluoride a specific aluminium works, has put into the air. This is no new request. The Aberdare Royal Commission, 97 years ago, recommended:

> " . . . That all recorded escapes, with the names of the works in which they occurred, be published in the annual report of the chief inspector. . . ."

The recommendation was not adopted and the Alkali Inspectorate (mistakenly, in my opinion) have opposed its adoption. The manufacturers' objection, that disclosure might give away trade secrets, is totally discredited. The Alkali Inspectorate's objection, that the data would be misinterpreted and might be mischievously used in litigation and that disclosure might be inimical to their co-operation with industry, has more substance; but not enough to satisfy public opinion. I agree with the conclusion of Social Audit:

> "If anyone now tried to prevent the release of equivalent data on the balance of payments, unemployment or the weather on similar grounds, the argument would be recognised as an absurdity."(27)

At long last, Parliament has taken a step to release to the public information about the wastes put into what is, after all, their environment. Section 82(5) of the Control of Pollution Act 1974 states: " A register maintained by a local authority [of total volume of gases discharged from individual premises, concentration of pollutants, and total of pollutant discharged, etc.] shall be open to public inspection at the principal office of the authority free of charge at all reasonable hours." This will not happen, however, unless the local authority applies to the Secretary of State to approve enabling regulations. May I hope that Sheffield, which is the paradigm for an industrial city in its smoke control, and which in 1960 took over 31 works previously registered with the Alkali Inspectorate, will be the first city to have such a register.

I said at the beginning this was a case history of a success story. Slowly, since 1863, social values about air pollution have been raised (the history of smoke abatement, which I could have taken as a theme for this lecture, points the same moral) and polluters have had to comply to new social norms. At considerable cost, too: the Alkali Inspectorate alone, which deals with only a small segment of air pollution, reckons that industry spent £324 millions over the years 1958 to 1968 in the control of noxious vapours. There is still room for improvement and ground for criticism. But for my theme the important conclusion is that the pragmatic philosophy has, by and large, worked for the five reasons I gave you just now. Imperfect though it is, we do have the beginnings of a technique for integrating scientific data and social values into policy decisions about the environment.

Let me end by leaving you with two questions, neither of which I can answer. They are both important and they will soon have to be answered.

Here is the first one. You can regard the inputs (scientific and social) for the political decisions we have been discussing as being fed into a human computer, who supplies the answers. For noxious vapours this computer is not the Minister (though he is ultimately responsible) and not (as so often in America) the Courts: it is the Alkali Inspector. He is entrusted with making political decisions on behalf of the public without being directly accountable to the public. I think he does the job well. But I come to my first question: *Will we the public continue to allow experts to make political decisions on our behalf without ourselves participating?* The mass media now ensure that we are educated (too often, alas! miseducated, by the man who slants the TV camera) in the scientific input for political decisions. We already possess, intuitively, the social value input. We, the public, have wanted, and for air and water pollution we have now been promised, access to some of the technical data on which decisions are made. I believe these circumstances will lead to new and difficult problems in the politics of the environment, for the public may wish to assume (some would say "usurp") the present political functions of some experts. If we no longer delegate such functions to technical experts, will we get better, or worse, management of the environment? The dilemma is that people are making demands upon governments which are inconsistent with the way they want to be governed.

And here is the second unanswered question. We have reason to be optimistic about the politics of the British environment. Our air and rivers are cleaner than they have been for 150 years; we have sensible laws about planning and conservation and the disposal of waste on land and at sea. *But can this efficacious pattern of control be extended to other and much more difficult* *political decisions where science and social values have to be integrated?* Over re-cycling of scarce materials; or the discouragement of built-in obsolescence; or the conservation of energy; or the long term policies over nuclear waste; or unlimited right to procreation? I leave you, as an academic should, not with solutions, but with problems. But I do leave you also with the suggestion that historical studies may contribute toward their solution.

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PASSENGER TRANSPORT AND THE ENVIRONMENT

A major inter-disciplinary conference on Passenger Transport and the Environment is being arranged in association with the Royal Institute of British Architects, the Institution of Municipal Engineers, the Royal Town Planning Institute, the Chartered Institute of Transport, the Institution of Highway Engineers and the Society of Industrial Artists and Designers at the University of York on Thursday, 25th March and Friday, 26th March 1976. The Conference is being organised by the Construction Industry Conference Centre Ltd.

The Programme will include sessions on Public Transport in the Urban Structure, Passenger Transport in the Local Environment, New Developments in Passenger Transport and Design for Public Transport.

Details can be obtained from: CICC Ltd., P.O. Box 85, High Wycombe HP13 5LJ. Tel.: 0494-21791.

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INTERNATIONAL NEWS

CYPRUS

A 70,000 gallons per day, transportable reverse osmosis water treatment plant has been installed at the Alethrico borehole near Larnaca, Cyprus. It will undergo a nine-month test programme, first at Alethrico and subsequently at four other boreholes with different feedwaters, to demonstrate its capability for producing drinking water in useful quantities from lower grade waters, to assess membrane performance and fouling rates with different feedwaters and to obtain further experience of plant operation and reliability.

The Ministry of Overseas Development, the UKAEA and British industry have collaborated with the Water Development Department of the Cyprus Ministry of Agriculture and Natural Resources in this programme which results from a report, made in 1972 by the then Water Research Association, on various aspects of Cyprus's water resources and requirements. The original proposal was for a single-module mobile commercial plant but, at the urging of the Cyprus Government the scope was increased to the present plant in which three different types of membrane with a common feedstock treatment plant and a total output capacity of 70,000 gpd are tested simultaneously.

The Ministry of Overseas Development has met the cost of the equipment. The programme has been organised, under contract to the Ministry, by the Authority's Desalination Group at Winfrith, whose engineers have also supervised the installation of the equipment. Ames Crosta Ltd have supplied one reverse osmosis module and Paterson Candy International Ltd the others, together with the feedwater treatment plant. The Cyprus Government provided and modified two trailers on which the equipment is mounted and a mobile diesel generator to supply power for the pumps; they are also providing the operating staff for the plant.

INDIA

Head Wrightson Process Engineering Ltd. in association with Head Wrightson India Ltd. have been awarded contracts to the value of £5m for the design, supply, erection and commissioning of the suppressed combustion gas collection, cooling, cleaning and storage systems for two new 300 tonne LD steel making furnaces to be installed at Bokaro Steel Ltd., Bihar, India. This will be one of the first LD plants outside Japan to incorporate storage, cleaning and productive use of the combustible carbon monoxide that is produced during the steel-making process. The Head Wrightson design is based on experience gained on eleven existing storage systems.

The suppressed combustion systems will be designed by Head Wrightson using the IRSID/CAFL process. Gas cleaning will be carried out by high energy wet scrubbers. These will again be of Head Wrightson design under their Research Cottrell licence. Bokaro Steel Ltd,, a Government of India undertaking, is the largest iron and steel complex in India and is scheduled under current development plants to produce ten million tonnes per annum.

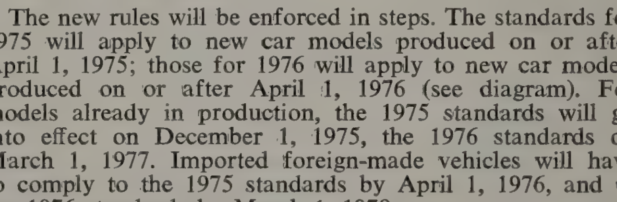
JAPAN

As part of the measures for curbing environmental pollution caused by motor vehicles, new controls on exhaust gases were imposed in April 1975 and stricter controls will go into effect in April 1976.

Japan started to enforce controls on exhaust gases in 1956 and these controls were gradually tightened but the regulations which took effect last April differ radically from the earlier rules. Because these regulations changed the conditions under which motor vehicles operate, they will have a very strong impact on demand for automobiles. Below is a short explanation of the main provisions of the regulations which came into force in April 1975 or will take effect in April 1976.

1. Sphere of application

The regulations apply only to newly produced motor vehicles. The standards which came into force in April 1975 apply to passenger cars and light trucks and buses (vehicles with a gross weight below 2·5 tons); those which will be enforced in April 1976 will apply only to passenger cars. The new regulations do not affect large trucks and buses, motorcycles and used cars.



Note: The head of the arrow indicates the end of the period during which production of cars conforming to the respective standards is allowed.

2. Date of enforcement

The new rules will be enforced in steps. The standards for 1975 will apply to new car models produced on or after April 1, 1975; those for 1976 will apply to new car models produced on or after April 1, 1976 (see diagram). For models already in production, the 1975 standards will go into effect on December 1, 1975, the 1976 standards on March 1, 1977. Imported foreign-made vehicles will have to comply to the 1975 standards by April 1, 1976, and to the 1976 standards by March 1, 1978.

3. Standards

Emission standards have been established separately for different types of vehicles, engine cycles and fuels. For each of the three major pollutants, a permissible level (highest tolerance) and an average emission level have been fixed. The 1975 standards for four-cycle gasoline engines of passenger cars with an equivalent inertial weight of less than 1 ton (equivalent inertial weight = weight of vehicle + 110 kg) reduce the average emission level of carbon monoxide (CO) to 2·1 g/km and that of hydrocarbons (HG) to 0·25 g/km, both about one-tenth of the 1973 levels. The permissible level of nitrogen oxides (NO_x) emissions has been fixed at 1·6 g/km, one-half of the 1973 level; the average has been set at 1·2 g/km.

In 1976, the emission of NO_x must be further reduced.

For passenger cars weighing less than 1 ton, the permissible level will be cut from 1·6 g/km to 0·84 g/km, the average level will be lowered from 1·2 g/km to 0·6 g/km, a reduction of 50%. For passenger cars weighing more than 1 ton, the new permissible level will be 1.2 g/km, three-fourths of the 1975 standard (1·6 g/km); the average level will be 0·85 g/km, about 29% of the 1975 standard (1·2 g/km).

These standards are the strictest in the world, but the NO_x content of exhaust gases will have to be reduced further in 1978. The 1975 standards for light trucks and buses are less strict and provide for a reduction of CO and HC to about seven-tenths and of NO_x to eight-tenths of the 1973 level. Standards for 1976 have not yet been settled.

The most notable effect of the new exhaust controls will be the rise in prices. The enforcement of the 1975 standards will increase prices of passenger cars by about 10% and prices are expected to rise another 2-3% when the 1976 go into effect. Moreover, fuel economy and performance will be adversely affected by the new standards. Because the standards are less strict for light trucks and buses, they will have almost no effect on prices and performance of these vehicles.

FRANCE

Rhône-Poulenc has taken delivery for its chlorine manufacturing plant in Lavera, Southern France, of the 1000th Brink mist eliminator manufactured by Monsanto Enviro-Chem Systems Inc. (Europe) since production started at the company's Gentbrugge, Belgium plant in 1972.

The Brink elements for the Lavera plant are designed to remove mercury and sodium hydroxide particles from the hydrogen stream after the electrolysis process. In this application Brink elements provide 100% efficiency on particles above 3 microns in size and 99·3% on particles below 3 microns. Rhône-Poulenc is already successfully using Brinks for filtering sulphuric acid particles from the exit stacks of sulphuric acid plants at Grand Quevilly, France and Sas van Gent, The Netherlands. The elements are also used in Rhône-Poulenc's chlorine plant at Pont de Claix, France.

NORWAY

The Norwegian Government has put before Parliament a programme to eliminate pollution in rivers and lakes. It is planned to cover a period of 15 years and will cost approximately 18,000 million NKr., of which 12,000 million represents direct public expenditure. The total amount required for drainage works up to the year 2000 is estimated at 45,000 million NKr.
(Council of Europe Newsletter).

EEC/BRUSSELS

On 18th July the EEC Commission proposed a number of uniform measures for the nine Common Market countries to reduce and progressively eliminate the pollution of the sea by "red mud" (titanium dioxide). The directive proposed to the Council of Ministers of the Nine contains three types of provisions:

— industrial enterprises will be required to obtain prior authorisation from the competent authorities of the state in which they are situated;

— the area in which "red mud" is dumped will be ecologically monitored for hazards to marine fauna and to man;

— a plan to reduce pollution and nuisances will be drawn up. The reductions envisaged rise from 30% in 1978 to 95% in 1985 for old industrial plant and from 70% in 1978 to 95% in 1985 for new plant. (Council of Europe Newsletter).

IRELAND

Two pollution laboratories are at present under construction at the National Institute for Higher Education campus at Plessey, County Limerick, and are expected to be in operation by September 1975. The laboratories will have highly sophisticated equipment; one of them will deal specifically with the latest methods of pollution control and the other with effluent control relating to liquids. (Council of Europe Newsletter).

CALL FOR PAPERS

The International Union of Air Pollution Prevention Associations are the sponsors and the Japanese Union of Air Pollution Prevention Associations Hosts of the 4th International Clean Air Congress to be held at the Tokyo Prince Hotel, Tokyo, from 16th-20th May 1977. Papers on the following subjects are called for:

1. Principal subjects
   1.1 Countermeasures and technical methods for air pollution abatement in air quality control regions
   1.2 Methods of air pollution prevention at sources
   1.3 Clean air through new technologies
   1.4 Clean air policy; education and training; public relations

2. Profile subjects
   2.1 Effects of pollutants
   2.2 Criteria and standards
   2.3 Influence of meteorological factors on air pollution
   2.4 Physics and chemistry of atmospheric pollutants
   2.5 New method of measurement (emission and environment)
   2.6 Survey and monitoring systems
   2.7 Role of fiscal policies and taxation
   2.8 Cost estimate for air pollution control facilities
   2.9 Clean air through regional and urban planning
   2.10 Status of legislation in various countries
   2.11 Others

3. Arranged by branch subjects
   3.1 Combustion in industries and space heating
   3.2 Combustion in power stations
   3.3 Iron and steel industries, non-ferrous metal industries, foundries
   3.4 Air pollution from vehicles and aircraft
   3.5 Chemical industry
   3.6 Petrochemical industry, refineries
   3.7 Cement, lime, brick and ceramic industries and building techniques
   3.8 Waste disposal and recovery
   3.9 Mining
   3.10 Agriculture and livestock farming
   3.11 Others

Abstracts of not more than 200 words should be sent to the Secretary General of the NSCA not later than 16th February 1976. The salient features of papers only will be presented at the Conference. Written papers should not exceed 4000 words. The Registration fee for authors will be reduced by 50% to 75 U.S. Dollars.

During the same period, an Exhibition will be held at the Tokyo International Trade Fair Ground. Brochures on the Congress and Exhibition can be obtained from the Society, Tel: Brighton 26313. It is hoped to publish details of travel arrangements shortly.

Research Programme Demonstrated at the Warren Spring Laboratory Open Days, 16th-20th June 1975

The National Survey of Smoke and Sulphur Dioxide continues with the co-operation of Local Authorities and other bodies; daily measurement taken at some 1200 sites in over 350 diverse towns are analysed at Warren Spring Laboratory. The 1974 Department of the Environment Report on Monitoring of the Environment in the U.K. recommended some expansion of Government-financed air pollution monitoring. W.S.L. has embarked on measurements for sulphur and a number of elements, including heavy metals in suspended particles, to be carried out at 20, mainly urban, sites. Oxidants and hydrocarbons are to be studied initially at three sites.

Air pollution modelling research has been extended to the development of a detailed national picture of smoke and sulphur dioxide as a basis for estimating the technical and economic implications of various air quality levels. As a factor in industrial, residential and other development decisions, the importance of predicting air-pollution levels is increasingly realised.

The Scottish Development Department has commissioned W.S.L. to study the distribution of sulphur-dioxide and smoke, and their relation to emission sources, in the Forth Valley. Large scale industrial development, including two power stations and an oil refinery, together with the Forth Valley's growth potential, makes it a useful site for the preparation of a model to predict the effects of changing emission sources (e.g. the addition of new sources) in a given survey area. A mathematical diffusion model describing the area's air pollution characteristics, combined with regional meteorological and topographical data plus domestic, commercial and industrial fuel consumption figures, can be used to quantify the contribution within and outside the area to measured concentrations, and quantify the contribution from various sources within the area to the observed concentrations. With the aim of extracting the greatest amount of useful data from the fewest ' fixed ' monitors, these have been located in areas of different emission characteristics, having regard to the likely spatial variability of the pollutant, and, to a lesser degree, the prevailing meteorological conditions. In rural areas, sites are located in relation to important distant sources. A total of 40 to 45 monitors are in operation at any one time in the Forth Valley.

Warren Spring Laboratory is participating in the OECD Co-operative Project initiated in 1972 to study the drift of pollution on a continental scale. Ten European countries are attempting to determine the relative importance of the contribution of local and distant sulphur pollutants to air pollution over a region. Special attention is being paid to the transfer of pollution to ground-level. Emission data and measurements of various sulphur compounds are being taken on a regular basis for three years in a network of sites. Measurements are taken in the air (readings made with the aid of instruments in aircraft) and on precipitation, the results being collated and analysed at the Norwegian Institute for Air Research. NILU has developed dispersion models which, together with emission and meteorological data, can predict the concentrations of airborne sulphur compounds throughout N.W. Europe. Incidents of gross pollution (e.g. excessive acidity of rain) can therefore be related to particular sulphur emission sources.

To provide independent data on U.K. emitted sulphur dioxide, its behaviour and fate, W.S.L. are participating in a U.K. co-ordinated project. Sulphur pollutants are sampled from aircraft and at ground level sites, emission estimates are taken and dispersion models are made from this data. The uptake of sulphur dioxide by vegetation is being given special study.

The DOE has commissioned Warren Spring Laboratory to undertake a three year programme of research and development on odour measurement and abatement. Industries and local authorities which have helped to finance the programme are able to direct the work through the Steering Committee. The Working Party on the Suppression of Odours from offensive and selected other trades is also co-operating in this research.

(Crown copyright W.S.L.)

A mobile laboratory has been designed to provide an odour-free room and an odour source under one roof. The unit has three sections, in one of which is the operator's room, containing Dynamic Dilution Apparatus, which measures odour by an organoleptic assessment of intensity. Odour at controlled dilution passes to the Odour Room, which is approximately 11ft × 7ft and supplied with air passed through active carbon-filter to remove odours. In here, observers stand at three sampling points to detect odour in different tests. Results are obtained by proportioning the volume of clean air necessary for 50 per cent of the panel of observers to barely detect one volume of odour. A portable/transportable version of the rig is being developed for exterior assessment by local authorities and other interested bodies.

The thermal destruction of odours has been examined to determine the requirements and efficiency of this method. Most odours are combustible organic compounds, producing oxides of carbon, hydrogen, nitrogen and sulphur when burnt. A thermal temperature of 600°-900°C is required to destroy odours in a reasonable time (approx. 0·5 secs). The fuel costs are therefore high, and more attention needs to be paid to heat recovery systems and the possible use of existing on-site boilers. More examination of efficiency control variables is also necessary. Pilot-scale experiments are planned to establish performance and design criteria for use in a portable large-scale model for experiments in various U.K. establishments.

Tests are being made on the treatment of odours with ozone. Ozone can be cheaply produced in sufficient supply to act as a powerful oxidising agent in malodorous gas streams. To function properly, ozone must oxidise very low concentrations of pollutants to an odourless product in a very short time—between 10 and 20 seconds at most. A high concentration of ozone (TLV: 0·1ppm) must be avoided at all stages of the process. The rate of reaction with ozone has proved too slow for the effective reduction of many malodorants. Ozone has some use as an odour counteractant in a confined space. However, the effect is lost when effluent is dispersed in the atmosphere. Ozone can also reduce odour levels by preventing bacterial growth.

Absorption in liquid is a common method of odour removal from gas streams. Large quantities of water are required and the method is not suitable for compounds only slightly soluble in water. In a pilot-scale absorber, tests have been carried out with various chemical reactants to increase the liquid capacity for odorants and allow recirculation. The reactants are either neutralizing agents (alkalis/acids) or oxidising agents (sodium hypochlorite; potassium permanganate). No single reactant will work with all malodorants, a combination of two probably being required. It is both economical and practical to put a larger amount of reactant (10 to 100 times the stoichometrical amount) into the liquid and recycle the solution.

Investigations continue into the treatment of motor vehicle exhaust emissions. Facilities include an engine-dynamometer with full analytical instrumentation, used in the evaluation of possible commercial catalysts.

Organic lead compound has been used for the past forty years as an anti-knock additive to fuel spark ignition engines. World-wide concern has been felt about the atmospheric effects of the fine particulate lead compounds in exhaust gases, although there is no medical evidence conclusively proving these to be hazardous to health. W.S.L. have tested lead-trap devices for vehicle exhaust systems. Emissions have been monitored, particulate size studied, and road trials made with twenty vehicles in addition to the engine dynamometer tests. Results show that a 42 per cent overall reduction over the standard system can be achieved. (There is considerable variation with vehicle type). Performance of the lead trap is influenced by the exhaust gas temperature, path length and gas velocity. Lead trap materials seem to have a life exceeding 38,000 km. Lead accumulated in the trap can be emitted when the temperature and gas flow rates rapidly increase (e.g. moving from an urban road to a motorway). There is a significant reduction in the emission of particulates smaller than 10mm at speeds less than 80 kmh. At higher speeds, size distribution is similar to that of standard emissions, but the total emission of particulates is considerably reduced. An on-line monitor, using a portable atomic absorption spectrometer has been developed to measure exhaust emissions.

The survey of pollution from motor vehicles in five selected towns, undertaken in 1972 for the DOE, has continued. Gaseous pollutants are measured by continuously recording instruments sited on the kerbside of busy and poorly ventilated streets. The recorded levels are punched on paper tape every five minutes, and the data is processed by computer at W.S.L. Traffic density, wind speed and direction are recorded and processed. Lead and smoke levels are measured in 3-hourly samples by filtration. The relationship with gaseous pollutants is examined. The collected data has been analysed to show the daily, monthly and yearly mean values for pollutant concentrations. Seasonal effects are evident: highest values occur in low speeds in winter months. The exception to this is the ozone concentrations observed in Central London, where the highest levels are found with low wind speed on calm, sunny days. Elevated ozone levels are widespread in S.E. England when photochemical conditions exist. The conclusion drawn from these investigations is that levels at kerbside stations have not risen significantly in the last few years in U.K. urban areas with dense traffic. Results are similar to those of other European surveys.

In the prevention of marine pollution, the importance of treating oil spills is widely recognised. W.S.L. have made extensive researches into the collection of oil at sea, including the assessment of equipment for the recovery of oil after a major incident at sea, and similar studies on oil pollution of inshore waters. Beach collection and cleaning techniques have been designed and tested, and training given to oil pollution control officers.

Seven methods for the prevention and treatment of floating oil have been examined and assessed, and five for the treatment of oil on beaches, banks and inshore sites. Proven clearance methods are shown to be still the most reliable: at sea, emulsifying the surface oil with dispersant chemicals; on land using the same method after the initial collection of as much of the oil as can be physically scraped up and removed.

Dispersant chemicals are usually a mixture of hydrocarbon solvent with an emulsifier and W.S.L. have worked on the development of suitable dispersant chemicals for many years. Oil companies and other industries produced dispersants at least 1000 times less toxic than those used in the "Torrey Canyon" clean-up. Properly used to ensure penetration and energetic mixing, the dispersant will convert the oily layer into small droplets that do not coalesce again to form a slick. Sprayed in reasonable quantities, no additional environmental hazard is created. A tug-mounted dispersal rig has been given extensive trials by W.S.L. The most promising dispersants have been tested at sea: a new type of material, a 'concentrate' product to be diluted with a high proportion of sea water at the time of application, will improve the logistics of oil spill clearance operations at sea. "Pillow" tanks which allow sufficient quantities of dispersant chemical to be carried by an ocean-going tug, are now in full operational use.

Inshore equipment includes hand-spray lances for two men, fed by a floating hose from an offshore boat for beaches inaccessible from inland, or used in a totally inland operation. Periodic demonstrations of equipment are held at Warren Spring Laboratory for local authorities. The Department of Industry has initiated the establishment of full-scale anti-pollution defenses around U.K. coasts. Sixty tug-mounted sets are strategically located in thirty ports. The vessels can be at the sea area within a few hours of alert. A number of sets have also been supplied overseas. W.S.L. have developed a small device, which may be lowered from a vessel or a helicopter, to measure the thickness of an oil-slick at sea and obtain a sample. Work has begun on the development of an oily-water monitor after the provision made in the 1973 International Convention for the Prevention of Pollution from Ships for an oil-discharge monitoring system. The prototype determines oil content by infra-red radiation absorption. All hydrocarbons respond so the technique can be used to determine both persistent and non-persistent oils, as the Convention requires.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Autumn 1975)** *which gave the position up to* **30 June 1975.** *They now show changes and additions up to* **30 September 1975.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

As from 23 September 1974, the distinction between "black" and "white" areas has been discontinued. Because of this, the table showing the smoke control position in regions of England has been temporarily discontinued.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Northern

Gosforth D.C. (No. 7); Saltburn and Marske-by-the-Sea (Nos. 6, 7 and 14); Tynemouth (Nos. 18, 19 and 20) (1974); Whickham D.C. (Nos. 17, 18 and 19).

North Western

Atherton D.C. (Nos. 8 and 9); Bolton (No. 1, Little Lever No. 4) and (Halliwell and Westwards); Bury B. (No. 10); Bury (Tottington No. 5); Darwen (No. 14); Preston B.C. (No. 29); Rawtenstall B.C. (No. 8); Rochdale B.C. (Freehold and Drake Street No. 1); Stockport C.B. (Heaton Mersey/Heaton Moor and Heaton Moor/Heaton Norris); Swinton and Pendlesbury (Nos. 10 and 11); Trafford (Altrincham No. 13); Widnes B.C. (Nos. 12, 13 and 15); Wigan B.C. (Golborne District No. 4; Wirral (Bebington No. 25).

Yorkshire and Humberside

Bentley with Arksey D.C. (No. 7); Dearne D.C. (No. 9); Halifax C.B. (No. 20B); Horsforth D.C. (No. 33); Hoyland Nether D.C. (No. 4); Leeds (No. 119 East Hunslett (Low Road)); Rawmarsh (Monkwood) (Stage 3 No. 2 and Stage 2 No. 1); Rotherham (Canklow and Town Centre); Skipton D.C. (No. 10); Wakefield C.B. (Park No. 1).

West Midlands

Market Drayton (No. 13); Nuneaton B.C. (No. 13 Attleborough); Rugby (No. 16); Shrewsbury B.C. (No. 2); Walsall C.B. (No. 19); Walsall (No. 20 New Invention), (No. 21 Pelsall), and (No. 22 Aldridge Consolidation); Warley C.B. (No. 11); Warwick (No. 1).

East Midlands

Ashfield District (Nos. 1 and 2); Erewash D.C. (Ilkeston No. 10); Gedling D.C. (No. 1); Kirkby-in-Ashfield (No. 9); Northampton (No. 11); Worksop (No. 3).

London Boroughs

Brent (No. 14); Bromley (Nos. 22 and 23); Harrow (Nos. 30 and 31); Merton (Nos. 29 and 30).

South Eastern

Brighton (No. 1); Guildford B.C. (No. 2); Hemel Hempstead (High Street/ Piccotts End); Reading B.C. (No. 21 Whitley Rise/Basingstoke Road); Thurrock D.C. (No. 11).

South Western

Exeter C.B. (Barton).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern

Middlesbrough No. 18 (Ayesome Street/Devonshire Road), No. 19 (Town Centre) and No. 20 (Whinney Banks).

North West

Bolton M.B. No. 3 (Bolton B. No. 49); Chorley (No. 1); City of Manchester (Ringway); St. Helens (Ashton No. 2); Wigan (No. 13).

Yorkshire and Humberside

Calderdale No. 1 (Ripponden) and No. 3 (Hebden Royd/West End); Harrogate No. 7 (St. Luke's); Scunthorpe (No. 11).

West Midlands

Dudley No. 133 (Cradley); Wolverhampton No. 20 (Wightwick Area).

East Midlands

Blaby D.C. No. 9 (Braunstone and Leicester Forest East); Broxtowe No. 1 (Eastwood); Derby No. 30 (Osmaston); Lincoln (Nos. 11 and 12); Mansfield (No. 2); North Kesteeven District No. 1 (North Hykeham and Skellingthorpe).

London Boroughs

Bexley (No. 15).

South Eastern

Epping Forest (Loughton No. 1); Thurrock (No. 12).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern

Darlington No. 13 (Albert Hill); Gateshead No. 1 (Highfield/Rowlands Gill), No. 2 (Old Ford), No. 3 (Carr Hill) and No. 4 (Portobellow); Hartlepool (No. 30); Newcastle-upon-Tyne No. 2 (Castle Ward), Nos. 8 and 9 (Gosforth), Nos. 22 and 23 (Newburn) and Nos. 23, 24 and 25.

North Western

Bolton M.B. No. 4 (Bolton B. No. 50); Ellesmere Port (No. 13); Rossendale B. (No. 1); Warrington No. 2 (Thelwell); Wirral M.B. (Birkenhead No. 20 Woodside and No. 21 Mersey).

Yorkshire and Humberside

Calderdale No. 1 (Hepton Rural/ Blackshaw/Erringden), No. 4 (Hebden Royd/Cragg Vale), No. 11 (Todmordon / Portsmouth / Cornholme / Pudsey/Vale), and No. 21 (Halifax/ Bradshaw/Warley/Wainstalls); Doncaster No. 2 (Conisborough); Doncaster B.C. Nos. 3 and 4 (Tickhill); Scunthorpe (No. 11); City of Wakefield (Castleford No.2 and Normanton No. 2).

West Midlands

Birmingham (Nos. 159 and 530); Dudley No. 134 (Coobs Wood); Rugby (No. 18); Wrekin (No. 1).

East Midlands

Amber Valley No. 1 (Alfred Nutall Park/Alfreton), No. 2 (Amber Heights/ Ripley) and No. 3 (Charnwood/Wood Drive/Ripley); Lincoln (Nos. 11 and 12); Mansfield D.C. (No. 3); Nottingham (No. 7A).

SMOKE CONTROL AREAS

Progress Report

Position at 30th September 1975

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).
** Amended to comply with the D.O.E. for Northern Ireland figures*

	England			*Wales*			*Scotland*			*Northern Ireland*		
Smoke Control Orders Confirmed prior to 30.6.75	4,540			20			246			63*		
Acres		1,461,621			2,868			131,872			15,583	
Premises			6,539,277			10,499			564,078			41,951*
Smoke Control Orders Confirmed (30.6.75-30.9.75)	24			1			1			1		
Acres		10,734			44			584			—	
Premises			34,116			—			2,095			1
Totals	**4,564**	**1,472,355**	**6,573,393**	**21**	**2,912**	**10,499**	**247**	**132,456**	**566,173**	**64**	**15,583**	**41,952**
Smoke Control Orders Submitted (30.6.75-30.9.75)	47			—			—			—		
Acres		39,275			—			—			—	
Premises			72,014			—			—			—
Grand Totals	**4,611**	**1,511,630**	**6,645,407**	**21**	**2,912**	**10,499**	**247**	**132,456**	**566,173**			
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

London Boroughs
Hillingdon (Nos. 27-30); Waltham Forest (No. 26).

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Antrim D.C. (No. 4); Castlereagh D.C. (No. 1); Craigavon B.C. (No. 3).

NEW SMOKE CONTROL ORDER CONFIRMED BUT NOT YET IN OPERATION

Antrim D.C. (No. 4 variation).

SCOTLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Falkirk District (Grangemouth No. 7); Hamilton District (Blantyre West No. 2); Kircaldy District (Broomhill), (Chapel) and (Glenrothes No. 4); Renfrew District (Ralston/Old Hall).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Monkland District (Airdrie No. 3).

WALES

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Wrexham Maelor B.C.

SMOKE CONTROL ORDER WITHDRAWN

Langbaurgh (No. 1) Redcar Central.

POLLUTION FINE

On Thursday, 9th October, at East Ham Magistrates Court the Master and owners of the ship "Sugar Importer" were fined £25 each for permitting black smoke to be emitted from the funnel, when the vessel was discharging sugar at Silvertown.

The Prosecution was made by the Corporation of London, as the Port of London Health Authority, under the Clean Air Act 1956 and the Dark Smoke (Permitted Periods) (Vessels Regulations 1958).

NOISE CONTROL COURSE AT SALFORD

A course on noise control is being held at the Salford College of Technology, Lancs, every Friday afternoon between 16th January and 21st May 1976. The course will be of especial interest for Public Health Inspectors, Industrial Safety Officers, Building Technicians and others responsible for noise control. Fuller details available from Mr. R. B. Lamb, Salford College of Technology, Salford, Lancs M6 6PU.

BOOK REVIEWS

The Protection Handbook of Industrial Noise Control

by Peter Sutton, BSc(Eng), MIMechE. Published by Alan Osborne and Associates (Books) Ltd. 44 pages, £1·00

As its title suggests, this handbook is written for the industrialist and in particular the safety officer whose duties, certainly so far as noise is concerned, are likely to become far more extensive and complex as a result of both the HEALTH AND SAFETY AT WORK ETC. ACT 1974 and the CONTROL OF POLLUTION ACT 1974.

The booklet is of a useful size, clearly printed and succeeds in its endeavour to contain its information, on a subject still surrounded by a certain amount of mystique, to a standard which can be readily absorbed by an officer who is able to devote only part of his time to noise control and who may be responsible for making recommendations on noise control measures to his employer, or for discussing such requirements with local authorities' environmental health officers or Her Majesty's Factories Inspectorate.

In Chapter 1 the author discusses clearly and as simply as possible the basic terminology of noise and I am pleased to see that he recommends the purchase of a precision grade instrument for measuring works noise, as accuracy is all important and the 3 dB(A) error tolerance for industrial grade instruments is too great.

The second Chapter deals with a number of noise control techniques including the reduction of noise at source, its attenuation in transmission and the application of noise control techniques. Considerable space is given to the study of attenuation by ear defenders and whilst this is extremely useful to the safety officer I would have preferred to see emphasis being given to the principle that really this should be the last line of defence against transmitted noise. The illustrations in this Chapter are useful and explain the difference in attenuation throughout the frequency spectrum of various enclosures.

Dealing with noise control in practice the author sets out very briefly the legal position of the various criteria and standards applicable. In particular officers will find useful the extract from the Code of Practice for reducing the exposure of employed persons to Noise and the method described of planning a hearing protection programme. Environmental health officers, in particular, will know the difficulties that arise in dealing with planning applications where differing noise measurement specifications are submitted for varying types of plant and attention is drawn to this fact. It is to be hoped that the more frequent use of sound power level specifications will ease the problem. Excellent examples are given of various noise producing plant with recommendations on alternatives or sound insulating control methods.

When dealing with neighbourhood noise the author recognises that at last, when the Health and Safety at Work Etc. Act 1974 and the Control of Pollution Act 1974 become fully operative, both the employer and the employee will have a responsibility to see that their activities do not provide annoyance to inhabitants of the area surrounding their premises. The legal position is explained, reference being made to statutory nuisance procedure, common law rights and planning controls plus a very useful section on the importance of good public relations. Reference is also made to BS 4142 and whilst it remains basically the same, it was amended in January 1975 and I feel that mention should have been made of this fact.

The main part of the booklet is virtually identical to the first edition and new legislation is described in Appendix 1 with notes on sound power level in Appendix 2. It is a pity that the book was not published at a later date when this information could have been incorporated in the main text. However, in view of the economic situation and the resultant delays in implementing the legislation mentioned, perhaps the author was wise. The publication includes numerous references and a very good selection of text books on noise measurements and control.

For anyone not already in possession of the first edition, this is an excellent booklet and good value for £1, deserving a place, not only in the libraries of industrial concerns, but also those of local authority Environmental Health Departments.

L. H. Whanslaw

Environmental Sources and Emissions Handbook

Marshall Sitting. Noyes Data Corporation. 523 pages, $36

This book brings together in accessible form the meat of a large number of EPA contract studies of emission factors for various industries in the USA. The author expects it to be useful to operators or potential operators of polluting processes. In this country it would be of more interest to local authorities with control responsibilities and to teaching institutions with environmental science courses.

In the first half of the book pollutants are dealt with one by one with their various sources listed, while in the second half the emission factor data are usefully set out in the context of summaries of the industrial processes from which they arise. The book is a good guide to what to expect from different industries but a number of limitations must be noted. Attention is primarily paid to American industrial practice, the relative magnitude of sources in America and to American raw materials—fuels and minerals. These are not always relevant to the European situation. Then there is the quality of the data. An honest attempt is made to categorise the data sources; many are found to be unknown and therefore of questionable accuracy.

Some of the specific pollutant sections have not been too carefully prepared. For instance under lead there is a summary of emissions to air in the United States and only on the fourth page does it become clear that the major source—automobile emissions—has not been included in the summary tables. The figure is then given. Care is needed in extracting material from the book and the footnotes can be vitally important.

On the whole the Noyes Data Corporation have achieved as successful a compilation as in other volumes in this series but at this time the results must be treated as indicative rather than quantitative.

Dr. J. S. S. Reay

Pollution Engineering Practice Handbook

Edited by P. N. Cheremisinoff and R. A. Young. Published by Ann Arbor Science. 1073 pages. Price £9·72.

The editors of this book are respectively Associate Professor of Environmental Engineering at the New Jersey Institute of Technology and Editor of the "Pollution Engineering" magazine. Their aim, as stated in the preface, has been to produce a handbook that will enable engineers to find the most economical and effective solution to any pollution problem. The extent of their acheivement is evidenced by the wide range of pollution problems covered—namely Atmospheric, Water, Solid Wastes, Noise and Radioactive. The true extent of their coverage can only be disclosed by a summary of the main items of the 30 chapters as follows:

Chapter

1. Major sources of pollution—methods of dealing with them—setting up a Pollution Control Dept.—Importance of Public Relations—various factors affecting Plant Site selection.
2. Dry methods of particulate collection including Bag Filters, Precipitators and Cyclones.
3. West Scrubbers from Spray Towers to High Energy Scrubbers—Suppression of Steam Plumes—Mist Eliminators.
4. General information on Fans and Blowers—Ventilation of Buildings.
5. Equipment for monitoring and testing stack emissions.
6. Odour Control—Direct Flame Incineration—Catalytic Incineration—Rich Fume Incineration.
7. Sources of Odours—Methods of control other than Incineration.
8. Pollution control installations in various industries.
9. Work Area problems—List of many common gases and vapours affecting plant safety.
10. Effect on stack plumes of meteorological factors, topography and adjacent buildings.
11. Treatment of water for domestic and industrial use—Waste water disinfection and disposal.
12. Waste Water Treatment—Filtration—Flocculation—Flotation—Reverse Osmosis.
13. Aeration of waste water.
14. Metal Waste Reclamation—Cyanide Waste and Sulphite Mill Effluent Treatment—Removal of Commercial Dyes from waste water—A combined plant for cooling of Power Station circulation water and treatment of city sewage—Membrane Pond Liners.
15. Vacuum method for transport and collection of waste water.
16. Instrument for monitoring and control of waste water—pH control.
17. Disposal and recovery of oil wastes—Control of Oil spills and their measurement.
18. Cooling Towers—Sprays for cooling and pollution control.
19. Various types of Corrosion—Tables of corrosion resistant metals, ceramics, rubbers and plastics—Protective Paints and Coatings.
20. Solid Waste handling and disposal equipment—Common Industrial disposal practices.
21. Incinerators—Sludge Incineration—Wet Air Oxydation—Fluid Bed Reactors—Pyrolysis.
22. Volume reduction of solid waste—Shredders—Compactors—Mulchers.
23. Sanitary Landfilling—Area, Trench, Ramp and High Density systems—Composting.
24. Salvage and Recovery—Processing and Reclaiming—Magnetic Separation—Spray Drying.
25. Ocean Dumping.
26. Noise Compliance and Enforcement.
27. Noise measurement and personal protection—Sound transmission and absorption—Plant noise surveys—Hearing testing—Protection Devices.
28. Noise Sources and Control—Reduction Techniques—Solutions to common machinery noise problems—Hydro- and Aero-dynamic control of valve noise—Silencers—Office Noise—Computer noise.
29. Traffic Noise.
30. Airborne Radioactive Releases from Nuclear Power Plant. (Note: This deals mainly with releases from Boiling Water Reactors none of which are installed in this country.)

As stated by the editors, and this is clear from the bibliography, this book has been compiled largely from articles published in "Pollution Engineering"; use has also been made of articles from "Plant Engineering" and other sources. Unfortunately, in certain places there is unnecessary repetition, indicative of some laxity in editing; but more seriously, different figures appear for the same processes. The most extreme example appears in Chapters 26 and 27 but as these are all in relation to the U.S. Occupational Safety & Health Act they should not be of major concern to readers in this country.

There are also many examples of careless proof checking in the omission of root signs, differing figures at successive stages of calculations, incorrect titling and transposition of graphs and omission of scales. Most of these will be obvious to the reader except perhaps the different figure for the constant in the formula for the safety factor for cylindrical vessels under low vacuum on p. 146 and the example on p. 152.

The book contains many illustrations, diagrams, tables and graphs which are of great assistance in amplifying the text. In some cases, however, the graphs are on so small a scale that reading to the figures quoted in the text is not possible. Graphs to a larger scale, on folding pages if necessary, would have been welcome.

It is by no means clear why the authors should have chosen to give on p. 94 a formula for the time between cleaning cycles on bag filters which incorporates the porosity and ratio of volume to surface area of dusts, since the determination of these parameters is difficult. A simpler formula with tables of coefficients can be found in either "Determination of Cloth Areas for Industrial Air Filters" by C. Williams, T. Hatch and L. Greenborg (Air Piping & Air Conditioning—April 1940) or Section 6 of the Engineering Users Handbook No. 19—"Separation of Dust from Gases." (The time "t" has been omitted from the RH side of the formula on p. 94. The correct formula also appears in both the foregoing references.)

Contrary to the statement on p. 104 under the subheading "Electrode Unit" single stage precipitators have the discharge electrodes insulated from the shell and connected to a high voltage negative supply. The collecting electrodes are connected to earth as is the shell (casing). (Readers will no doubt note that fig. 2-11 on the preceding page shows one line of discharge electrodes connected to the H.T. supply and the other to earth!)

In the description of the impingment scrubber, p. 128, it is stated that saturation occurs in the humidification stage. This statement is questionable since true saturation is not achievable in this type of tower where water is injected into the gases. Provided, however, the gases on leaving the humidification stage are at or below dewpoint, condensation will occur and the gases will be approaching saturation. The definition of dewpoint temperature on p. 217 seems to accept this.

The neighbourhood treatment plant described in Chapter 15 is apparently being used to prove the feasibility of such small local systems pending the future installation of a regional plant. It is said to be an entirely new concept for treatment of domestic waste water.

A section of Chapter 16 which deals with the measurement of Oxygen demand and criticises the use of the five-day Biological Oxygen Demand as an index on the grounds that is subject to considerable error, ignores the fact that it represents only about 60% of the ultimate oxygen demand and fails to give immediate warning of serious spills. The editors point out that a correlation can be established between Total Oxygen Demand and five-day Biological Demand and recommend the use of the former for monitoring as it can be obtained "on line".

In the discussion on oil spills the editors emphasise the necessity of proper training of staff including the deployment of equipment. They instance a spill of 600,000 galls. near Long Island Sound handled so successfully that few people even knew of it.

The high density land filling mentioned in Chapter 23 is achieved with a machine called the Mole, which receives refuse direct into its hopper and disposes of it under ground at a pressure of 200 lbs. per sq. in. Once refuse is placed in the hopper it is not exposed to the surface again. The Mole operates in conjunction with a crawler type bulldozer and a bucket excavator. It is claimed that disposal costs compare favourably with other landfill methods and that it requires only one-third to one-half of the land for those methods.

This book is unusual in that it gives many cost comparisons and economic analyses to assist the reader. While these are, of necessity, based on American conditions there should be no difficulty in substituting the data and costs appropriate to similar problems in this country. For this reason and its extremely wide coverage it is a notable addition to the literature on pollution and is one that should be available for reference in all organisations, governmental and industrial, that are interested or engaged in the control and prevention of pollution.

Although space limitations make it impossible to cover any discipline to such an extent as to be of value to an expert in that discipline, pollution covers such a wide range of knowledge that nobody can be expert in all its facets. One must therefore agree with the claim that it is indeed a book that will be of value to experts.

E. R. Watkins

The Changing Global Environment

Ed. by S. F. Singer. D. Reidel Publishing Co., Dordrecht and Boston 1975. Cloth $39·00, Paper $18·50

In December 1968 a symposium on Global Effects of Environmental Pollution was organized by the American Association for the Advancement of Science at Dallas, Texas and the papers presented were published in the following year by the D. Reidel Publishing Co. as a book of the same title, edited by Professor Singer. The present volume of 24 chapters is, in effect, an expanded second edition of that book. Twelve of these chapters are reprinted either unchanged or with very minor alterations from the earlier work, three more are substantially expanded versions of chapters in that work, and the remaining nine are new. Neither the editor, in his introduction, nor the publisher, in his description of the book has thought fit to mention this connexion between the two volumes.

When a book is compiled, as is this one, by commissioning each chapter from a different author or authors, it is not sufficient for the editor to decide on the titles of the chapters, he must exercise firm control both at the stage in which the contents of each chapter are planned, but also when the first draft of each is received, if gross overlapping is to be avoided. Such control implies that the authors should produce chapters specially written to fit in with the plan of the whole book rather than get away with something they have previously written on the same subject for some other purpose. The amount of overlapping in the present volume makes the reader wish that Professor Singer had exercised much firmer control over his contributors. Considering the present price of books it is irritating to think that one is paying for unnecessary printing.

Having made these comments about the production of this book, it is a pleasure to go on to stress the scientific excellence of the contents. The book is concerned with the interchange of compounds of carbon, oxygen, nitrogen and sulphur—together with a few others—between the earth, the oceans and the atmosphere, and in particular with the effects undue accumulation of them in the atmosphere might have on climate. The greater part of the major pollutants in the air, globally speaking, arise from natural processes and are removed from the air by natural processes. The rates of these reactions are nicely balanced and the concentrations of the various components of the atmosphere set up in this way are such as to produce the climate to which we are accustomed and to which we, as human beings, have become peculiarly adapted. The fear has arisen in the last decade that as a result of the activities of man, pollutants are entering the atmosphere on such a scale that the natural self-cleaning processes can no longer maintain the correct concentrations in the air necessary for the maintenance of our climate, and that dire consequences may ensue. The contributors to this book have provided a detailed scientific account of all these matters. Their conclusion is that while there is as yet no evidence that things are getting out of hand as far as the global effects of pollution are concerned, a very careful scientific watch must be kept on the situation so that action may be taken at the very first sign of trouble. It will be recalled that this was also the conclusion of our own Royal Commission on Environmental Pollution.

S. R. Craxford

Perspectives on Energy—Issues, Ideas, and Environmental Dilemmas

Edited by L. C. Ruedisili and M. W. Firebaugh. 527 pages, £4·00

This book comprises an interesting selection of essays, mostly based on American experience and aimed primarily at the American public. It is eminently readable and provides much food for thought.

First, the dilemmas are posed. Such subjects as the realities of the energy crisis, the energy crisis in perspective and energy and the environment are discussed.

Next, fossil fuel energy sources are discussed in some detail. In this section, amongst other essays, are a useful survey of world energy resources and an examination of the challenge and promise of coal as a future source of energy. Nuclear fission as an energy source is then considered in some detail. The case for nuclear energy is made out by Dr. B. I. Spinrad, Professor of Nuclear Engineering at Oregon State University. The section later includes a study on reactor safety, an essay on the disposal of nuclear wastes and finishes with a report of a working group warning of the dangers of the use of nuclear power.

Logically, the fourth section of the book looks at the future and examines alternative energy sources. The quest for power from nuclear fusion, the use of solar energy and geothermal power, tidal power and wind power are all considered. There are interesting contributions on oil shale and oil sands. The curtain is lifted on the use of hydrogen and a plea is made for better use of the heat obtained from the incineration of rubbish.

The final section of the book is a collection of papers about the future and is headed 'Energy Policy Recommendations and Future Directions'. In this section the motor car and pollution are debated, the case is made out for energy conservation and the final essay is 'The Re-cycle Society of Tomorrow' by Dr. G. T. Seaborg, Professor of Chemistry at the University of California.

In our opinion this book serves two purposes. It provides a very useful reference work as dissertations on many kindred subjects are collected together. Unfortunately, it lacks an adequate index, although each separate article is well documented. But perhaps this is a book more to dip into. It is not necessary to read the book straight through from cover to cover; one can select one's reading and wherever one reads, something new and interesting is found.

WATER—1974: Vol. I—Industrial Wastewater Treatment and Vol. II—Municipal Wastewater Treatment

Edited by Gary F. Bennet. American Institute of Chemical Engineers' Symposium Series, 1975. 390 pages each.

This compendium presents papers by different authors relating to water pollution control techniques and legislation in the U.S. Severe problems have occurred, especially where discharges of largely untreated industrial and domestic waste have been made in vast quantities in inland waters. Not only has water quality itself been severely affected with the attendant destruction of aquatic life, but water requirements for municipal and industrial use have now to be assessed to ensure adequate supplies, while the treatment of these waters after use must be of sufficiently high quality to ensure that no further damage is caused, with a reduction in pollution levels achieved at the earliest possible date.

Vol. I is devoted to industrial wastewater treatment, with the papers arranged under the following headings: Industrial waste treatment; Socio-economic impact of pollution control; Flocculation and sedimentation; Reverse osmosis; Enzymes and wastewater treatment; Cold climate wastewater treatment; Oil spills; Activated carbon regeneration.

Examination is made in individual papers of different treatment techniques related to specific industries. Special attention is given to the Ferro-alloys industry, the Iron and Steel industries, and oil refineries. Some papers are devoted to research on pollutants arising from these production processes. The probable cost to major U.S. industries in complying with Federal water pollution control legislation has been studied in depth as an integral part of production costing.

In the section on Oil spills, a paper is included on the 1973 International Convention for the Prevention of Pollution from Ships. The controls agreed to in the Convention are outlined and their implementation examined, with especial reference to Canadian waters. Another paper discusses the Prevention of Pollution programmes currently being undertaken by the EPA and the US Coast Guard to solve the serious oil spill problems, this provides a useful comparison with control systems instituted recently around the UK coast. In the US, it is estimated that in spite of the great cost in time, labour and materials of clean-up operations, only 20% of spilled oil is recovered: both the environment and the world's energy resources suffered from the loss of a calculated 24 million gallons of oil in 1972 around US coasts.

A paper on terrestrial spillage of oil in the Arctic examines the prevention, clean-up and disposal methods necessary to ensure that land based spills do not migrate via drainage channels into water courses, thence to seas. The clean-up methods assessed are the usual skimmers, dispersants, gelling agents, sinkants and sorbents; but for spills on land, degradation by natural microbial activity is thought feasible, and combustion is also considered an attractive means of disposal in the Arctic in spite of the difficulties involved.

An interesting paper on oil spill drift forecasting describes an initial effort in the development of a refined forecasting model for oil spills. If predictions using such a model proved correct, crews can move to protect beaches in the drift path of a slick well before the oil reaches shore, and oil skimming equipment can be directed to areas of special biological significance where oil encroachment is probable. An early warning system on these lines applied to British coasts could prevent the increasing contamination of our tidal beaches, if allowances could be made for the scale and geographical situation of the British Isles.

Volume II contains papers on problems associated with municipal water and wastewater treatment. Problems associated with particular inland lakes and watercourses in the US are covered. The design of control technology and the optimisation of water pollution control systems are examined in papers under the following headings: Pollutants—sources and effects; Natural eco-systems; Phosphates and nitrogen removal; Optimisation of pollution control plants; Aeration: Municipal water and wastewater problems: EPA-DC Pilot plant studies; Automation of wastewater treatment plants.

These papers contain a wealth of highly technical data and information; sludge treatment and sanitary landfill operations with especial reference to the treatment of leachates generated from landfill are two of the subjects covered in a compendium which should provide a useful reference for practitioners in the field of water pollution control in the U.K.

Analytical Methods applied to Air Pollution Measurements

by R. K. Stevens and W. F. Herget. Published by Ann Arbor Science. 297 pages, £9·80

This book is a collection of papers emanating from the symposium at the meeting of the American Chemical Society in Dallas in 1973. It deals with the application of advances in chemistry, physics and electrical engineering to air pollution measurements. The fourteen papers are organised within three sections, the first deals with methods of measuring gaseous pollutants at ambient concentrations, the second discusses procedures to characterise properties in the atmosphere and the final section describes instrumental methods for the analysis of gaseous and particulate pollutants at source concentrations. The book covers gas-filter correlation spectroscopy, comparison of classical and newly developed X-ray fluorescent methods for measuring elemental composition of particles and advances in techniques for extracting gaseous and particulate pollutants from power plant stacks. It also describes the application of chemi-luminescent techniques to measure ambient concentrations of gaseous pollutants and two new techniques for measuring sulphuric acid vapour at ambient temperatures.

It discusses these topics both broadly and separately. A rapid reading would convey to those involved in environmental control the latest developments in analytical methods but for a real understanding of the content a good grasp of the physical sciences is essential. It is therefore a volume, albeit a very good one, for the bookshelf of specialists or specialist libraries rather than for use by the many engaged in the day-to-day administration of pollution control.

D. F. Ball

New additions to the NSCA Library

Atmospheric Diffusion—2nd Ed. F. Pasquill. Ellis Horwood Ltd. 1974. £16.

Energy Environment Abstracts. Pollution Abstracts Inc. 1975. 979 pages.

Environmental Damage Costs. OECD Seminar, 1972. OECD 1974. 332 pages. £4·50.

Management of Plutonium-Contaminated Solid Wastes. Proceedings of the 1974 Marcole Seminar, organised by the OECD Nuclear Energy Agency.

Perspectives on Energy. Ed. L. O. Ruedisili and M. W. Firebaugh. Oxford University Press, 1975. 527 pages. £4.

Pollution Engineering Practice Handbook. Ed. Cherimisinoff and Young. Ann Arbor Science. 1975. 1073 pages. £9·72.

The Protection Handbook of Industrial Noise Control. Peter Sutton. Alan Osborne. 1975. 44 pages. £1.

The Protection Handbook of Pollution Control. Peter Sutton. Alan Osborne. 1975. 80 pages. £1·50.

CEGB Annual Report and Accounts 1974-5. £1.

Chemical & Biochemical Methodology for the Assessment of Hazards of Pesticides for Man. WHO Scientific Group Report. (Technical Report No. 560). 1975.

The Determination of Atmospheric SO_2 after Collection on Impregnated Filter Paper. C. Healy and D. F. Atkins. U.K. AERE Harwell. February 1975. HMSO. 50p.

Preparation of PAN and its Determination in the Atmosphere. F. J. Sandalls, S. R. Penkett, B. M. R. Jones. U.K. AERE Harwell. November 1974. HMSO. 50p.

Progress in the Prevention and Control of Air Pollution in 1974. Report to Congress. U.S. EPA.

CURRENT PUBLICATIONS RECEIVED BY N.S.C.A. LIBRARY

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POLLUTION ABSTRACTS

Papers presented to the International Clean Air & Pollution Control

Conference incorporating the 42nd Annual Clean Air Conference

20-24th October, 1975.

INTERNATIONAL ATTITUDES TO THE CONTROL OF POLLUTION

5 Air Pollution Control—A Comparison of Approaches. Dr. L. E. Reed and Dr. M. T. Westaway (Central Unit on Environmental Pollution, Department of the Environment).

Different Air Pollution Control Procedures employed by several countries are examined. Each system has been developed to suit the individual requirements of their country, and while authors make no comparisons on the merits of these systems, they do examine the important components of an Air Pollution Control Procedure.

Although there is still insufficient information on the effects of pollution, enough is available on some pollutants (i.e., smoke and sulphur dioxide) to specify levels which, if exceeded, will produce an adverse response in sensitive individuals. Some countries have now used the data to establish air quality standards or objectives. In so doing, both man and his environment should be protected but in such a way that industrial development is not stultified by inappropriate regulations. A uniform standard for a whole country is nonsense if it creates a licence to pollute in rural areas and yet prevents sensible development in areas designated as industrial zones. Most countries recognise this and concentrate action on areas with excessive pollution.

THE UNITED KINGDOM APPROACH

6 The United Kingdom Approach and its Application by Central Government—Standards of Emission for the Scheduled Processes. M. F. Tunnicliffe (H.M. Deputy Chief Alkali & Clean Air Inspector, Health and Safety Executive).

The Alkali Inspectorate, as the principle operating agency of central government in the air pollution field, have set down standards in 1975 under the Alkali Act for emission from scheduled processes. After a brief review of the major changes and development of pollution control since 1966, with reference to bodies instituted by the government to research and advise on control procedures, the author explains the principle of ' best practicable means ' and the general philosophy and policy of the Alkali Inspectorate towards the formulation of emission control standards. He outlines the present quantitative emission limits for the scheduled processes. The testing and monitoring of emissions is discussed, including procedures for deciding the appropriate height of discharge for different processes in different circumstances. In the next decade, the author predicts great changes in the development of environmental controls, with a need for a greater collaboration and a genuine interchange of views between control agencies at local, national and international level.

7 The United Kingdom Approach and its Application by Local Government. T. H. Iddison, M.B.E. (Chief Environmental Health Officer, Dartford District Council).

The history of air pollution legislation from 1875 to the present day is discussed. Between 1875 and 1956, the emphasis in smoke abatement was on pollution so obvious as to make action virtually imperative. The law was hedged with provisos which made it extremely difficult to abate any but "black" smoke, which was not defined. The fact that smoke of other hues might cause an equal nuisance and a greater danger to health was little regarded. Although both the 1875 Public Health Act and the 1936 Act required Local Authorities to cause their districts to be inspected for the detection of other airborne nuisances, the sanctions available to them were limited.

The Clean Air Act of 1956, owing its origin to the Beaver Committee report, set the stage for the steady increase of local authority activity in all aspects of air pollution investigation and control. Each local authority then determined its own approach and degree of involvement in the light of its own air pollution problems, if any existed. The author discusses the progress in domestic smoke control; problems of smoke emission from industrial sources; other industrial emissions; and air pollution from road vehicles.

THE EUROPEAN APPROACH

8 Pollution Control in the E.E.C. S. P. Johnson (Head of Prevention of Pollution and Nuisances Division, Environment & Consumer Protection Service Commission of the European Communities).

The fight against pollution and nuisance is the first objective of the Community Environment Policy approved in 1973. A standard for data evaluation and a common framework of reference and methodology are necessary for action at Community level. The preliminary requirements and details of the E.E.C. plan are outlined. Priorities include a list of quality objectives and the determination of standards, which could be temporary and will at first mainly concern water pollutants. Specification of pollutants should be harmonised within the Community; studies of particular industries will continue with greater effectiveness when an international basis of understanding is achieved. Especial reference is made to the problem of toxic wastes' disposal and reduction. Affected zones of common interest are shown to need detailed co-operative study. Implementation of Common Research Programmes and the planning of a European establishment to document pollution information will back up this action programme.

9 Criteria and Standards for the Protection of Man and his Environment in the Environmental Action Programme of the European Communities. Dr. P. Recht, Dr. J. Smeets, Dr. W. Hunter (Health Protection Directorate Commission of the European Communities, Luxembourg).

The E.E.C. Action Programme on

the Environment is examined with respect to the determination of the critical effects of pollutants, standardisation of measurement, and finding gaps in the knowledge of pollutants and their effect. Present knowledge of toxicity has decided which pollutants require priority investigation; a revised list of second category pollutants has been drawn up for later consideration.

The determination of criteria is explained and the contribution towards this in the fields of occupational health, animal studies, toxicological studies and epidemiology is assessed. Environmental quality standards, product standards and process standards are included in the Action Programme so that a 'basic protection level' can be achieved and a 'no-effect level' indicated. Factors in achieving the accurate measurements necessary for standard setting are discussed. Harmonisation of methods is equally important. Common research and development programmes avoid duplication and the unnecessary waste of energy and resources.

10 A New Approach to Standards. Dr. L. A. Clarenburg (Rijnmond Authority, Director of the Department of Environmental Hygiene, The Netherlands).

The merits of setting air quality standards are considered. Present standards based on dose-effect relations are shown to be inadequate in the enforcement of an abatement strategy which has to compete with other national priorities. They do not take synergistic effects into account, they allow pollution to rise to the level specified and they have no bearing with regional development planning. It is considered feasible to formulate new standards which are partly based on dose-effect relations and partly on political choice, with attendant ease in international harmonisation and in compiling with regional development planning. The merits of real time standards, enabling responsible authorities to manage air pollution levels under critical meteorological conditions, are also discussed.

Although these suggested standards would greatly improve the existing situation, they do not reflect the real burden of pollution on the population. New environmental indicators which express the excess stress exerted on the population by a polluted environment could lead to the development of truly new standards, which relate to the joint influence on the population of air pollution, noise and a feeling of being endangered, and to the particular nature of areas inhabited by different sections of the population.

CONSERVATION OF RESOURCES

11 Development and Conservation of Human Resources to Assure Environmental Quality. Prof. C. E. Barthel, Jr. (Director, Institute of Environmental Sciences, Miami University, U.S.A.).

This paper studies the development of educational methods and manpower planning in clean air and pollution control, with particular reference to the U.S. educational system. Since the late 1960's, environmental studies have been instituted at every level including the establishment of centres offering a new type of education focused upon environmental awareness and quality.

Interdisciplinary education, beyond the confines of separate departments or colleges, is shown to be necessary for training in environmental sciences and related studies. Students require an education that permits them to deal with rapid change rather than one that provides a set body of knowledge. Miami University's Institute of Environmental Sciences is used as model of such a programme, offering a broad understanding of the environmental problems facing society and a solid basis of training in the problem-solving process.

Training programmes, instituted by the U.S. E.P.A. and other professional associations and societies, are examined. In spite of economic recession, the author concludes that human resources for air and environmental quality activities will be in great demand, especially for a new type of operator able to integrate and pull together the contributions of persons in varied fields of specialisation.

12 Non-renewable Mineral Resources for the Future. Prof. F. Roberts (Brunel University, London).

Greater priority needs to be given to studying future mineral requirements and their possible sources. The three general classes of non-renewable resources as distinguished by Nolan are outlined; the author advocates allocating each non-renewable mineral individually to optimum use, and finding the correct use of resources.

Scarcity may arise in advance of actual physical exhaustion of the world's supplies, due to the very uneven distribution of minerals over the earth's crust. The situation for raw material importers such as the U.K. could become very serious. Factors affecting the life of a mineral resource are described, and the relationship between minerals, their source and the estimation of total reserves, is illustrated.

The rise in real cost of mineral extraction as consumption increases is discussed, with a table illustrating the elasticity of the supply of selected minerals in 1973. A constantly rising demand for minerals, anticipated from previous demand curves, might reach a point where these non-renewable resources are exhausted. In reality, the author predicts a demand curve likely to take the shape of a logistic, in overall, as assumed by Hubbert, which he illustrates in Section 4 of the paper. Taking copper as an example, the author studies the possible life-cycle of a non-ferrous metal, using a 'modified—Hubbert' approach, and in conclusion, stresses his concern about long term future planning for the use of our mineral resources.

TECHNICAL ASPECTS OF THE CONTROL OF INDUSTRIAL POLLUTION

13 The Prevention of Pollution by Gases from Industrial Installations. M. J. P. Detrie (Ingénieur civil des Mines, Directeur du Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique, France).

Current attempts to reduce emission of gaseous pollutants from industrial installations are summarised; the situation of the main industries emitting each gas is considered. SO_2 and SO_3 are the most widely encountered pollutants, emitted in the combustion of virtually all fuels, the sulphur content of which enables emissions to be calculated. Although SO_2 and SO_3 have been studied in depth, their development and conversion in the atmosphere into acid precipitations or sulphates is still being researched and latest results suggest that these sulphates might be more injurious than SO_2 is known to be.

All countries are attempting to reduce the level of emissions due to combustion and industrial processes. Three approaches towards pollution prevention are examined: desulphurisation of fuels; desulphurisation of combustion gases; and process modifications in the purification of waste products.

Nitrogen oxides are considered to be the pollutant of the future, and the means for preventing their emission are still being studied. NO_x emissions from combustion and from chemical industries are examined. Problems encountered with carbon oxides, hydrocarbons and solvents, chlorine derivatives, and fluorine compounds are also discussed. Relevant statutes in various countries are outlined, including a summary of gas emission standards adopted by the F.D.R. in July 1974.

14 Technical Aspects of the Purification of Industrial Effluents. Dr. F. Malz (Emschergenossenschaft, West Germany).

The principle possible situations concerning effluent discharge and exhaust air emission are explained. The technical aspects of industrial effluent purification are considered in general, and, in this context, the technical environmental protection measures which are intended to achieve both cleaner air and cleaner water, without either purification process giving rise to greater pollution in the other sphere. The author demonstrates this mutual relationship with a practical example concerned with the effluent exhaust air interface. Various methods of exhaust air treatment are discussed and components which produce odours are mentioned.

Two significant events highlighted industrial effluent purification in the F.D.R. in 1974: (1) The commissioning of the mechanical stage of the Emscher mouth clarification plant (level with Duisburg) and (2) the BASF large scale clarification plant (at Ludwigshafen). These measures are making a substantial contribution to the reduction of the pollution burden of the Rhine. The plants are coping with effluent in an amount equivalent to that produced by more than 10m people.

15 Toxic and Other Hazardous Wastes. R. A. Fish (Greater London Council, Scientific Branch).

This paper deals with industrial wastes, a large part of which have traditionally been disposed to land. These may be solids, sludges or liquids and may pose a hazard to health, safety or the environment if disposed of as normal refuse or effluents, e.g. in a normal landfill site or to sewer. Legislation to date is discussed and it is pointed out that the Control of Pollution Act 1974 marks an important step forward from the Deposit of Poisonous Waste Act 1972.

The ideal shape and geographical site for a tip is discussed as are hazards which can occur with tips which are less than satisfactory. Tipping is not the ideal method for the disposal of persistent toxic or other hazardous wastes, and its use should be reduced to the minimum. Problems which could arise from disposal to deep mines are outlined.

Legislation covering dumping at sea and the problems involved are examined. The need for caution is stressed, as knowledge of the long-term effects of many wastes on the marine environment is limited.

Incineration and pyrolysis are covered as alternatives to disposal into the environment. Methods of treating various wastes to render them safe for normal disposal are discussed. The main classes of industrial waste are summarised with ways in which they are, or could be, disposed. Various methods of toxic metal recovery are looked at. The author concludes with the important technical aspect of the safe transport of toxic and other hazardous wastes to the disposal site.

ENERGY FROM THE CONTINENTAL SHELF

16 Exploration. J. M. Bowen (Shell U.K. Exploration and Production Ltd.).

The theme of this paper is the exploration part of the oil business in waters offshore the U.K. Not all explorers look ultimately for oil or gas, sometimes just for data and information to sell. Any geophysical method other than deep drilling is permitted.

Main exploration methods are discussed, including remote sensing techniques in the early stages using airborne magnetometer and seaborne gravimetric surveys to find possible ' oil patches '. The basic stages of the seismic reflection method are outlined with the aid of annotated diagrams.

Stress is laid on the importance of accuracy and integration of all known data. From recordings made and then computer processed, possible, but limited, oil patches are found: these may then be further investigated by the drilling of ' wildcat wells ' at a cost of £2m. The cost of oil exploration and its relativity to the degree of success is emphasised.

17 Production and Pollution Control. F. G. Larminie, O.B.E. (The British Petroleum Co. Ltd.)

The paper opens by examining the geological structure of the North Sea to show where reserves have been found: an oil province in the Northern North Sea Basin and a gas province in the Southern North Sea. The author explains why oil from the Norwegian sector is piped ashore in the U.K. A typical production system is described with emphasis on the anti-pollution and general safety measures incorporated into each part of the system. The effect of water depth, weather, predicted sea states and seabed conditions are described as factors in design which affect the choice of structure and materials. A semi-submersible rig is described to show deck lay-out, manufacture and installation. Safety methods incorporated into the operation are shown with reference to well design and drilling.

The main features of a produce/store/load at sea system are briefly considered. The decision to employ this method has to be carefully made in the light of the hazardous North Sea conditions, which can put a great strain on storage capacity. The dissolved-gas content of the oil is also difficult to remove at sea without wasting a subsidiary, but valuable, energy source.

It is shown that the design of the submarine pipeline achieves a strength which could be discontinued by valves; on land, however, the pipeline has valves on each side of all major river crossings so that sections can be isolated if necessary. Bringing the pipeline ashore requires careful attention to landscape environment in order to conceal the path of the pipeline; however trees cannot be replaced because of the danger of root systems interfering with the pipeline.

Finally, the storage and export facilities for the oil and gas are shown with reference to the environmental and aesthetic factors in design, which includes noise insulation at the plant and safety measures to avoid oil spillages.

18 'North Sea Oil—In Context and Perspective'. H. B. Greenborough, C.B.E., (Chief Executive and Managing Director, Shell Mex and B.P. Ltd.).

Discoveries of gas and oil in the North Sea have involved huge private capital investments at a very high risk. Seismic techniques, as used by Shell to estimate reserves, still carry this high risk in exploration, and Shell are less optimistic than the Government about reserves in future licence areas. Reliance should not be placed on exaggerated estimates of the North Sea's ability to cope with future energy demands, to the detriment of research and expenditure on alternative energy sources. The U.K. finds have been impressive, but are still only 3% of the total world reserves.

North Sea gas, discovered over 10 years ago, before the oil, now provides over 90% of British Gas supplies. Recovery depends on rates and methods of production used, therefore natural gas reserves are difficult to estimate. Delays in the Frigg and Brent fields have been disappointing and costs for separation and treatment plant have been high. Substantial additional supplies will be needed to meet future demands; substitute natural gas will have to supply the deficit, with reliance on coal and imported fuels, unless natural gas reserves prove much greater than those calculated to date.

The author presents Shell's energy demand estimates, explaining the factors in rise and fall of demand. He emphasises the advantages to the U.K. in the discovery of North Sea resources at a time of economic recession. But because capital expenditure on oil exploration has been very high, with loans and imports from overseas, competitive advantages generally will be more hardly won. Firm oil depletion guidelines from the Government are necessary so that North Sea oil will not be used as a variable pressure economic lever. North Sea oil will not meet all our own demands; we will have to import crude for heavy fuel oils. It is unrealistic to imagine the U.K. as a treasure island of oil riches amidst a declining Western Europe. Oil is essentially an international business, with attendant commitments and responsibilities for both government and industry.

POLLUTION FROM ROAD VEHICLES

19 One Man's Car—Another Man's Poison? Dr S. Reed (Greater London Council, Scientific Branch)

This paper concentrates on what can be done, particularly by local authorities, to mitigate the effects of pollution from road vehicles. Methods to improve conditions on existing roads are examined and emphasis laid on the importance of careful planning and design, taking environmental factors into account from the outset.

The reduction of both noise and air pollution from road traffic is discussed; for example, screen-blocks may be incorporated into new housing developments near roadways. In some cases, where measures have been taken to reduce audible noise, this may lead to an increase in disturbance from road traffic because of the low frequency noise problem. In conclusion, Dr. Reed suggests that if the money spent on noise insulation were to be devoted to anti-pollution controls on new vehicles, then everybody living near roads would benefit from less noise and lower pollutioin levels both inside and outside the home.

20 The E.E.C. Philosophy of Control. D. Verdiani (Directorate General XI, Commission of the European Communities)

The control of emissions from road vehicles is examined with reference to the formulation and application of E.E.C. control procedures. Removal of technical barriers to trade produced important consequences for the environmental policies of the E.E.C., requiring quality controls at all stages of road vehicles' production. A harmonisation of national provisions for control on quality, performance and use of products was produced, which was then aligned within E.E.C. directives, allowing the manufacturer to choose between the procedure of his own member state, or the appropriate E.E.C. directive. Nations at different stages of economic development, with diverse environmental stresses, have these differences resolved at Community level, producing a general raising of standards.

Bringing experts from all members of the E.E.C. together has helped to advance knowledge on pollutants. Requirements for the protection of public health and the environment have become far more severe. Progress in car construction has made it possible for manufacturers to comply with more stringent requirements, so directives on air pollution have been adapted to technical progress through a simplified procedure. The need to strike a balance between the benefits to man and the environment and the econominc consequences of pollution prevention methods is discussed. By 'harmonising' without delay every relevant national regulation, and following a logical approach from criteria concerning health risks, to air quality standards, finally to appropriate standards for industrial products which are known to cause pollution, this balance can be achieved in the future development of controls.

21 Control of Pollution and Noise from Automotive Sources. D. Collins (Ricardo & Co. Engineers (1927) Ltd.)

Current legislative requirements in the U.K. that have to be met by engines for use in road-going vehicles are described. These cover gaseous exhaust emissions such as hydrocarbons and carbon monoxide, diesel exhaust smoke and noise from both diesel and gasoline engines. Some of the regulations in force at present will be replaced by E.E.C. legislation which is very similar in all cases and will not reduce standards. Some non-legislated emissions currently being studied are also briefly mentioned.

The public have become more aware of the problem of pollution and noise from the increasing volume of traffic in the U.K. Some pollution, e.g. the heavily smoking diesel engine, is more obvious than others, but the most obvious is not always the most harmful to health. Legislation introduced without due consideration of the problems and costs involved in compliance and implementation only brings itself into disrepute with authorities and manufacturers. This does not mean the legislation should be delayed until a perfect solution is evolved, but very often the first solution is not the best and some consideration of the experiences of other countries can be worthwhile.

Regarding legislation concerning gaseous emissions, exhaust smoke and vehicle noise as applicable in the U.K., the author describes test procedures used for applying the legislation and the problems involved in compliance. Ricardos are actively involved in conducting tests to all procedures described in the paper and also in research into areas of pollution not yet covered by legislation.

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Rehabilitation of Ironstone Workings

by

R. J. Cowan, FRICS, CEng, MIMinE

and R. Dean, ARICS

"More moved by what impresses the senses than by what is addressed to reason." MACAULAY HIST. ENG.

This paper was presented at the A.G.M. of the East Midlands Division 12th June 1975.

It is understandable that there should be public anxiety about ironstone working because a bad impression may be created by the visual evidence of scars running through the rural countryside. Each scar consisting of a trench up to 100 feet in depth with apparently sterile heaps of overburden deposited alongside, the whole operation presided over by giant earth-moving machines.

How many observers stop to consider that that trench is moving forward at the rate of perhaps 100 yards a year and that the field of peacefully grazing cattle or growing corn alongside was itself an opencast mine restored only a few years earlier?

This paper sets out to show the other side of the picture—a side which the general public does not see and does not stop to consider.

Historical background

Iron is the fourth most abundant element, and, in the United Kingdom, precipitates are to be found in the Jurassic and Cretaceous measures which extend in a belt from the Cleveland Hills of Yorkshire, through the East Midlands to the South Coast.

There is ample evidence that this ironstone has been worked since Roman times and it is quite usual to find iron slag in excavated villages of the Iron Age, that is from about 500 B.C., in this country. The principal areas being in Dorset and parts of Hampshire where the ferrous sandstone was close to the surface, if of poor quality.

At the time of the Norman conquest, Gloucestershire, more particularly the Forest of Dean, vied with the Weald of Sussex and Kent as the main iron-producing centres. There is also reference in the Domesday Book to iron forges in Northamptonshire in the vicinity of the British Steel Corporation's Corby Works which has the only surviving iron-making plant in the United Kingdom relying solely on home-produced ironstone.

Woodlands provided the charcoal and ironstones the ore and this combination was the key to the location of early ironworking. It accounted for the initial establishment of iron making in the South and Midlands and the first stage of its transfer to the North arose only from restrictions on the cutting of trees.

These restrictions started in the reign of Elizabeth I because forests were becoming denuded of valuable timber needed for the maintenance of the navy. They paved the way for Dudley's revolutionary introduction of coal in the 17th century with the result that iron making gradually moved towards the North to be in convenient proximity to the coalfields.

Exploitation

Ironstone has then been worked in wide ranging areas of the United Kingdom, with varying degrees of intensity, over a period of nearly 2,500 years. Should we not then ask ourselves where is the devastation or pollution left by this mineral working? The fact is that there is more evidence of the deforestation which has taken place than of the iron working.

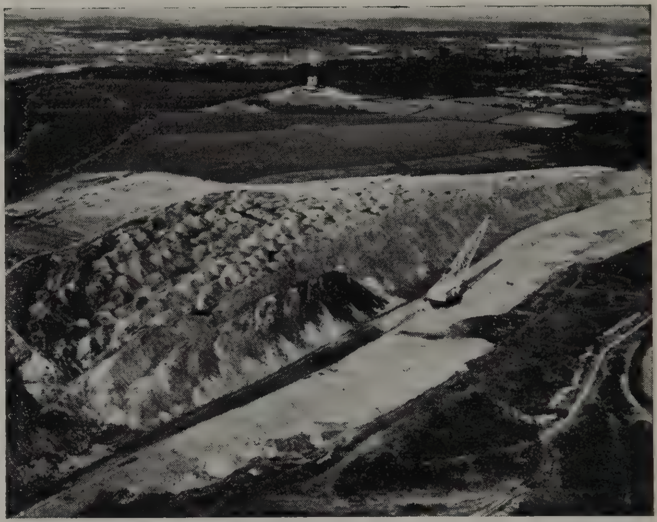


Fig. 1 Cowthick Quarry. Corby town and steel works in background. Woodland area on left planted on land worked and left as hill and dale. Middle area restored with topsoil and reinstated hedges, small diamond pattern is a shelter belt; land adjacent to quarry is hill and dale ready for restoration.

Historically there are probably two main reasons why our rural environment does not bear the scars of past working—

1. Geologically, ironstone is a sedimentary deposit and has been worked on the outcrop. As recently as 1911 leases were being granted giving the lessees the right to abandon ironstone lying at a greater depth than 20 feet as being commercially unworkable.
2. Environmentally, ironmaking was a village industry and ironstone has traditionally been worked by a rural community who levelled the site and returned the topsoil after extraction of the mineral.

Up to the commencement of the 20th century the working of ironstone was manual. The soil was taken off and put to one side, then both the overburden and the ironstone were removed by hand. The method employed was to wheel the overburden in barrows over long, wooden gantries and to tip it in the previously excavated areas. Finally the surface soil was replaced and the land returned to agricultural use leaving only a lowering of the surface as evidence of the mineral extraction.

With the 20th century came the introduction of excavating machinery, first to load the ironstone into wagons and then to strip the overburden. This still presented no real difficulties so far as the after-treatment of the land was concerned as the draglines used could deposit the overburden in a reasonably level state by casting the loaded bucket beyond the boomhead. By the use of manual labour and farm machinery the semi-levelled land could be brought to a condition suitable to receive a layer of topsoil.

In 1933 the situation changed radically with the introduction first of shovels capable of removing overburden to a depth of 60 feet and, by 1950, large walking draglines which could remove overburden to 100 feet. Because of the weights being handled these machines have a fixed point of drop directly under the boomhead. The result is to leave the overburden in a ridge and hollow formation, generally referred to as "hill and dale".

The difficulties are accentuated by the depth of working in areas where the overburden contains a high proportion of limestone, in some places as many as four separate beds with the consequent problems of blasting and handling. Although every effort is made to place the bulk of the limestone at the base of the spoil-heap it is inevitable that much becomes mixed with the other clay spoil and shows itself at the surface after levelling.

Administration and Finance

There was, in 1933, no earthmoving equipment, of the capacity of modern tractor and scraper units, which was capable of levelling these banks. The problems was considered first by a committee set up in 1938 and headed by Lord Kennet and then in 1944 by Mr. A. H. Waters. Without putting forward a practical solution both concluded that the means must be found to return the hill and dale to productive use at the same rate as virgin land was disturbed by the extraction of the ironstone.

The Town and Country Planning Act 1947 brought mineral operations under the control of the planning authorities but, in the case of ironstone, the Minister exercised his power to "call-in" all planning applications. All decisions since that date relating to the extraction of ironstone have, after consultation with all interested parties, been made by Central Government instead of Local Government as in the case with other minerals.

The Mineral Workings Act 1951 established an Ironstone Restoration Fund to provide money for the after-treatment of land worked for ironstone. The payments into the Fund have been varied by the 1971 Act and various Statutory Instruments and now stand at 3p per imperial ton contribution by the mineral producer and 0·3125p (¾d) from Central Government funds. Where the minerals are leased the producer can recover from the owner up to one-half of the 3p contribution provided that the amount so recovered has a maximum of one-third of the royalty payable under the lease or a minimum of 0·46875p (1⅛d) which was the owners contribution in 1951. In addition the producer is required to carry out restoration at his own expense up to a limit of £410 an acre.

Payments may be made out of the Fund as follows:

1. To the ironstone producer, the cost of complying with planning conditions over and above the £410 an acre.
2. To owners, where they have the expense of replacing buildings, hedges and field drains and in respect of extra costs incurred in the management of restored land.
3. To occupiers, where the cost of farming the restored land is higher than comparable operations on unworked land. This applies mainly to the purchase of additional fertilizers required to bring back full fertility.
4. To local authorities where they carry out the levelling of worked ironstone land.

Within ten years of the passing of the 1951 Act local authorities had made use of the Fund to level the bulk of those areas which had previously been left unlevelled, but no topsoil was available for respreading. Some 2,000 acres were dealt with in this way at a cost of about £200,000.

The ironstone producers have restored their current workings progressively, mainly with full replacement of topsoil, at the rate of about 400 acres a year to keep pace with extraction at a cost to the Fund of about £2·6 million. The cost of full restoration rose gradually from around £250 an acre in 1951 until recent years when it has escalated rapidly to about £1,000 an acre. The producers have been the principal contributors to the Fund and the money paid to them represents a sharing out of money obtained from all opencast ironstone workings to those areas where after-treatment is most costly.

Grants to owners and occupiers towards bringing the land back to a good state of cultivation or afforestation are administered by the Ministry of Agriculture Fisheries and Food and have amounted to about £700,000. The distribution of this sum is of considerable importance as the responsibility for the long-term success of any form of after-treatment must fall on the shoulders of land owners and farmers. A high standard of land management is essential and full advantage of the legislation must be taken to ensure a continuing improvement to the land.

RETURN TO AGRICULTURAL USE

A great mistake of many local planning authorities when dealing with other minerals was their determination to make conditions attached to mineral planning permissions rigid. They were motivated by the desire to pin down the producer to specific commitments. Unfortunately, and often to the detriment of the land, such rigid conditions have not stood the test of time and change.

It is to the great credit of the Department of the Environment that they adopted a much more flexible approach and in the main attached only a general condition to ironstone permissions to the effect that the overburden should be levelled to contours which would facilitate natural drainage and permit the resumption of normal agricultural operations. The interpretation of that condition has resulted in a continuing dialogue with the Department's Ironstone Adviser and account has been taken of change in machinery availability and in land use requirements.

Contouring

"Levelling overburden" misled many people in the early days into seeking to obtain a level or flat finish, but experience over the years has shown that the subsoil should be contoured to produce gentle undulations which will facilitate a natural surface run-off after rain but not so steep as to produce major erosion.

Where the end use is agricultural it has been found more satisfactory to achieve off-site drainage, but, for other uses, on-site drainage may be both acceptable and advantageous. It is often less costly and the natural beauty of lakes can add to the amenity value.

Topsoil

The separate stripping of topsoil and its re-use is governed mainly by the length and depth of the working face and the amount of hard and unfriable limestone in the overburden. This is recognised in the conditions attached to ironstone planning permissions and about two-thirds of the land worked has had the benefit of full topsoil restoration.

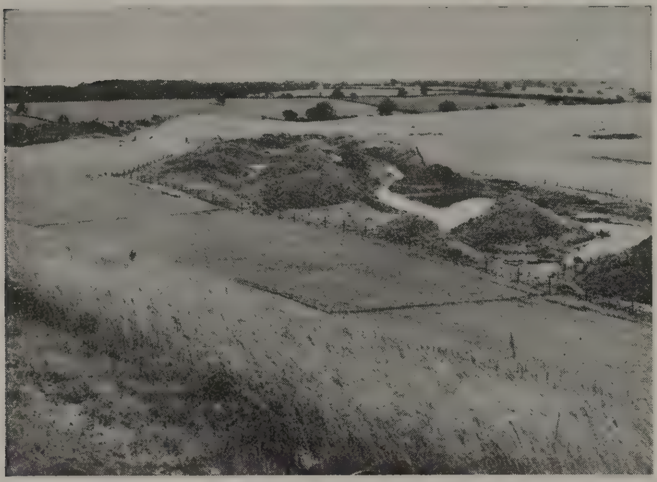


Fig. 2 Priors Hall Quarry. View of golf course in 1961. The fenced off area containing the water and rough ground has been left for posterity to show what the land was like before restoration. Trees are now established in this area.

Because restoration is progressive the majority of the topsoil is stripped and re-spread so that the problem of deterioration is not present. Where it has been necessary to store topsoil it would appear that a certain loss of nitrogen and organic matter has taken place in the dump.

In those areas where a full thickness of topsoil is returned, that is, about nine inches, serious farming problems have not arisen and the land can return to an economic cropping system provided a reasonably high level of management is exercised.

The benefits of spreading a thin layer of topsoil, say, less than four inches, are not so clear although undoubtedly it makes an appreciable difference to the germination and development of a grass crop in its early years, especially on sites where there is a lack of friable material in the subsoil. In the long term it achieves little that cannot be brought about at less cost by the seasonal application for fertilizers although the cost of these has risen rapidly in recent months and in some cases they are difficult to obtain.

The long term use of such land is confined to grazing and the thin layer of topsoil may well be better employed by spreading it at full thickness on a smaller area which will eventually support normal arable rotation of crops.

Non-topsoiled areas

Ryegrass-clover leys and lucerne can be successfully established. Lucerne is probably the most productive but its management is far less flexible and is less suitable for a district where part of the husbandry is concerned with fattening stock.

Experiments on this type of land have been carried out over a long period and generally show that the subsoil is deficient in the major plant nutrients, especially nitrogen and phosphates. There has also been limited bacteriological and entomological research including the establishment of earthworm populations.

The physical conditions have a significant effect on the cultivation of non-topsoiled land but naturally vary from area to area and it is impossible to generalise. In Northamptonshire, stones and boulders in the spoil and poor drainage of the clays aggravate the situation and the land responds unfavourably to both dry and wet climatic conditions. In other districts where limestone brash has been present fair crops of grass have been grown but the land is difficult to manage. In North Lincolnshire, where there is an absence of limestone and the subsoil is composed of lower lias clay, alluvium and blown sand arable crops have been grown satisfactorily.

The aim in the treatment of these areas must be to encourage the formation of a soil structure and the creation of humus. Successful experiments have been carried out on a limited scale but, so far, very little light has been thrown on the rate of soil-profile development although it is known to be slow.

Drainage

The land is contoured to facilitate a natural run-off and immediately after the levelling operation open ditches are normally cut to confine and direct the disposal of surplus rainwater.

A more difficult problem is to achieve adequate drainage down to a depth of about three feet in the heavier clays where a lack of porosity in the subsoil can effectively cut off the oxygen supply to the plant roots with disastrous results on fertility.

Because of settlement in the form of dishing of the levelled land the installation of extensive tile drainage would be folly within a period of about ten years. By the end of that time experience has proved that as a general rule they are not essential in all cases. Even in the long-term expenditure on tile drainage can only be justified on limited and specific farming grounds.

Mole drainers, subsoilers and rooters are difficult to operate where there are large limtestone boulders in the subsoil but they have been successfully used in the early periods of cultivation and it is becoming clear that subsoil drainage is a problem which must be dealt with in the course of the farming and not the levelling operation.

Heavy earthmoving machinery, as used for levelling and topsoil spreading, may create a panning effect although there is little evidence to show that the pan consists of anything more than a crust a few inches in depth. The long-term effect of this panning may have been overstated in the past because of the problem it creates in the first few years of cultivation. It's likely that the differential subsidence which takes place in the restored land creates lateral stresses in the subsoil which effectively breaks up the crust and frost action and root penetration will do the rest. Nature, given assistance at the appropriate time, may, in the long term, achieve the best results.

Stone-picking

A major rooting and stone-picking operation is not essential to the esablishment of grass on non-topsoiled land as experience has shown that this can be achieved satisfactorily with only limited stone-picking and cultivation, albeit with some risk of damage to farm machinery.

Expenditure on stone-picking can sometimes be justified where it permits easier initial cultivation and offers the prospect of more flexible ley farming systems which should give a higher return to the farmer than would permanent grass.

Although the later use of subsoilers is more difficult rooting and removal of boulders and stone from regraded land on which a full length of topsoil is to be spread cannot be justified because of the time factor involved and its consequent interference with the normal sequence of restoration operations.

Afforestation

Most of the woodland taken for working has been replaced and, in some cases, concentrated into more manageable blocks. Initially it was the policy to plant the young trees on the hill and dale as soon as possible after working. The loose spoil and steep slopes provided excellent drainage and the trees became rapidly established without competition from weeds and other undergrowth. The benefit derived in the early years has since been found to be offset by the problems of maintenance and withdrawal of timber. It is therefore the present policy to prepare the land for timber growing to contours specially suited for that purpose.

The common Alder will establish itself quickly in the worst subsoil conditions in the ironstone area. From the point of view of providing quick cover it is extremely useful but it has little timber value.

The type of tree best suited for forestry cropping depends largely on the predominant constituents of the overburden such as boulder clay and limestone but mixtures based on larch, sycamore and pine have generally proved successful. Woodlands established in this way have been accepted by the Forestry Commission into the Woodlands Dedication Scheme.

ALTERNATIVE LAND USE AFTER RESTORATION

The policy of the Department of the Environment and supported by Local Planning Authorities is that land restored after ironstone working should normally be returned to agricultural use as soon as practicable after the extraction of the mineral. It is estimated that over 95 per cent of all land taken has been returned to farming or forestry.

It has been recognised however that, in certain areas, worked ironstone land has a potential for purposes other that agriculture and the opportunity has been taken to accommodate development which would otherwise have entailed the taking of unworked agricultural land.

Heavy industry

Only the top part of the hard rock of the ironstone bed is extracted in the course of working and consequently a good base remains for piling. Heavy plant and precision machinery would require piles even on virgin land so that there is little extra cost in construction. Development has followed within three years of restoration with few problems.

At Scunthorpe and Corby much of the steelworks were developed on land following the extraction of ironstone and in the neighbourhood of these works many other examples are to be found.

Residential Development

In a number of Northamptonshire towns such as Desborough, Kettering and Wellingborough houses have been built, apparently without ill effect, on shallow ironstone areas worked out in the 19th century and in the pre-planning era possibly without knowledge of that earlier ironstone working.

The question now being asked is how quickly will the deeper areas be stable enough to support residential development. This is particularly important at Corby New Town where it is hoped that housing can follow levelling at a ten year interval in an area where extraction will reach nearly 100 feet.

At Corby in 1963, 24 houses were erected on an experimental site six years after it had been worked to a depth of 50 feet. No compaction was undertaken and subsidence of just over six inches was observed during the construction stage which was rectified in the course of building the houses. Settlement continued during the next three or four years but this diminished until virtually no movement is now taking place.

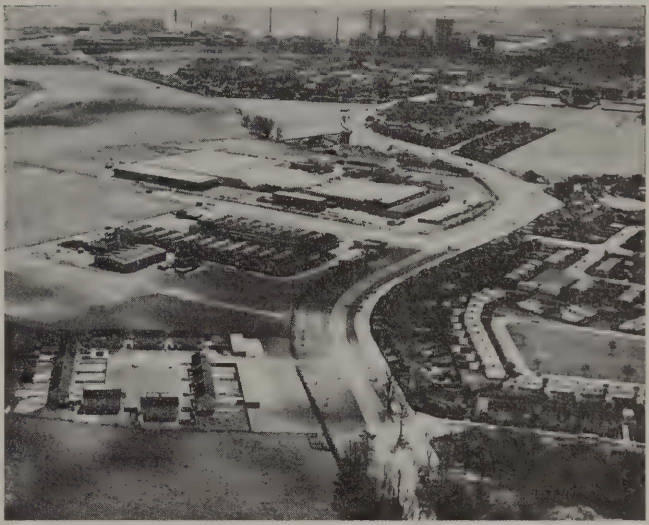


Fig. 3 Earlstrees Quarry. Land to left of road worked out and restored, quarry on extreme left. Restored land has been taken over for industrial development, houses and factories.

Various types of foundations were used from standard strip footings to reinforced concrete rafts on deep reinforced concrete perimeter beams. Damage to all the houses has been negligible and detailed observation has not been able to relate it to any particular type of foundation.

A further 21 houses are to be built this year on a site where the spoil had a depth of 90 feet and had levelled three years previously. In this experiment attempts are to be made to compress the ground sufficiently to take the weight of a housing estate. These tests are being carried out by the Corby Development Corporation in association with the Building Research Establishment which is responsible for monitoring the results.

Three methods are to be tried:

1. Dynamic Consolidation by which a 15 ton weight is repeatedly dropped on to the ground from a crane head at a height of 60 feet. Several passes are made and the intervals of drop carefully controlled.
2. Surcharge which involves temporarily heaping clay and limestone 30 feet high over the site to act as a giant weight.

3. Inundation whereby a lake is formed and the level of water is topped up as it is absorbed into the ground. The intention is to remove the finer particles by percolation and bond the earth closer together.

These experiments are of national importance and many areas in the country will be waiting for the results with interest. It must not be too readily assumed however that the effect of any of these forms of treatment will be beneficial as consolidation within the treated area may only be achieved at the cost of increasing ground movement in its surrounds.

It may well be that research into structures may prove more rewarding than placing too much emphasis on the need to speed up the natural process of subsidence.

Leisure

Possibly one of the most interesting examples of restoration for leisure use is the Priors Hall golf course near Corby in Northamptonshire which was purpose built in an area where, because of inroads from development, agricultural land was at a premium.

Under the planning condition attached to the site the area was to have been levelled to contours suitable for agriculture but because it had formerly comprised old woodland and because of the method of working there was no provision for the conservation of any topsoil.

In giving authority to form a golf course the Department of the Environment laid down only two criteria:

(a) That some features should be retained which, while being of assistance to the sporting nature of the holes, would show in perpetuity that the golf course had been laid out on worked ironstone land originally in hill and dale.

(b) That the initial movement of spoil must be done in a manner which not only assisted in the ultimate establishment of a satisfactory golf course, but also provided for the efficient movement of the material by the machinery available.

Contouring commenced in 1962 and the course was first opened for play in May 1965 although it was July 1967 before the Clubhouse was completed and the official opening took place with a match in which Eric Brown and Tony Jacklin participated.

Near Wellingborough, some thirty acres of hill and dale which had been afforested were acquired by the County Council for use as a Country Park. This project has proved so successful that another area recently restored has been contoured with leisure specifically in mind. Lakes have been formed to provide angling and wild life sanctuaries and eventually the area will be opened up for walks and other quiet leisure pursuits.

Some old abandoned quarries have become the haunt of birds and rare plants and have been found to be worth keeping as small nature reserves. Many are of fascinating interest to the geologist and are scheduled as sites of Special Scientific Interest. It is important to preserve some of these instead of the more normal treatment of filling by the tipping of waste materials.

CONCLUSION

There are large stretches of the country where a seam of ironstone has been extracted with little indication of the fact that the land has already delivered up its mineral wealth. The very success of the restoration after ironstone workings may be measured by its anonymity.

It is right that the public should not notice, either to criticise or applaud, what has gone before because it can then be truly said that the land has been absorbed back into the countryside.

CONFERENCE ON GASEOUS SULPHUR AND NITROGEN COMPOUND EMISSION

6-8 April 1976

UNIVERSITY OF SALFORD

The above Conference is being arranged by the North-Western Branch of the Institute of Chemical Engineers in association with the University of Salford.

The Conference has been arranged as a follow-up to review developments since the first Conference on Gaseous Sulphur Compound Emission in April 1973. It will be held in the Chapman Building of the University. It will provide a platform for an international exchange of technology and experience in the field of the control of gaseous sulphur and nitrogen compound emission into the atmosphere. The main topics to be covered are: Tuesday, 6 April, The Removal of Sulphur Dioxide; Wednesday, 7 April, The Control of NO_x Emissions; Thursday, 8 April, The Control of NO_x Emissions/The Removal of Hydrogen Sulphide.

Registration enquiries to Miss A. M. Tonks, Administrative Assistant, Conference on Control of Gaseous Sulphur and Nitrogen Compound Emission, Room 2, University of Salford, Salford M5 4WT. Tel: 061-736 5843, Ext. 449.

Technical enquiries to Professor T. Nicklin, Director of Technical Services, British Gas Corporation, Technical Services Department, Thomas Street, Stretford, Manchester. Tel: 061-236 4411.

2nd CHIMNEY DESIGN SYMPOSIUM AND EXHIBITION

From 30th March-1st April, 1976, the Centre for Industrial Consultancy and Liaison is organising the 2nd Chimney Design Symposium and Exhibition, to be held in Edinburgh.

The meeting is being organised in association with the International Association for Shell and Spatial Structures, IASS, Committee for Tower Shaped Structures.

The aims of the 2nd Symposium are to consider developments in the science and technology of the design and construction of chimneys. This will include appraisals of typical solutions to the overall problem, with consideration to initial and ongoing costs, together with environmental and aesthetic requirements.

Papers will be presented at the following sessions: primary design considerations, service aspects, linings and corrosion, design of shell and chimney foundations, available data and design management.

All enquiries should be made to the Symposium Secretariat, Centre for Industrial Consultancy and Liaison, University of Edinburgh, 14 George Square, Edinburgh EH8 9JZ. Tel: 031-667 1011 ext. 2369.

NEWS FROM THE DIVISIONS

EAST MIDLANDS

At 10.30 on Thursday, 4th September 1975, 70 members of the Division assembled at Peterborough in the Town Hall under the Chairmanship of Mr J. Jones, Chief Environmental Health Officer of Lincoln, Chairman of the Division for the current year.

A civic welcome was extended to those present by the Mayor of Peterborough (Councillor W. R. Cashmore) who reminded his audience that he was also the Deputy Chairman of the Division and speculated on his position if the Chairman had been unable to attend! Councillor Cashmore underlined the concern which the City of Peterborough had for pollution control and referred in particular to the Fletton Brickworks and domestic smoke control. The Mayor was suitably thanked by Mr. Jones.

The Secretary reported that at the Annual General Meeting of the Society earlier in the year Mr. T. Henry Turner had been created a vice-President, and the announcement was received with applause.

The Chairman then introduced Mr. R. Bertodo, Director of Engineering, Perkins Engines Group Limited of Peterborough who gave a review of developments at Perkins Engines entitled 'Engineering Diesels for Legislation'. The paper outlined the bewildering and unstable mass of legislation dealing with noise and also exhaust quality and looked at the technical and financial implications involved. Latest developments were described and the impact of the energy crisis considered. Mr. Bertodo proved to have the ability to impart a lively interest to a very technical assessment and his talk was received with evident enthusiasm.

Replying to questions Mr. Bertodo said he thought that the future lay with the development of spark assisted diesels. Asked how we as a Society could help, Mr Bertodo said the outstanding need was for the various authorities to AGREE on a testing method and upon levels of emissions. He did not foresee the diesel becoming generally used as a motor car engine—either one needed a calendar instead of a watch or the governor needed to be taken off the engine.

Mr. Bertodo was thanked by the Chairman on behalf of the members whose applause indicated their appreciation of the talk.

Following the morning meeting members of the Divisional Council were entertained to a buffet lunch by the Mayor and Mayoress. Councillor Charles Swift, leader of the Council and Mr. C. Peter Clarke the Chief Executive were also present.

After lunch a party of 30 members assembled at Perkins Engines where they were welcomed by Mr R. Seaton, Public Relations Officer to the firm, who gave some information about the size and activities of the company and the range of Engines manufactured. The group were conducted through the Development testing side of the undertaking which included an anechoic chamber and a whole series of engine testing cells, one of which was designed for testing engines in a tilted position. Various test rigs for parts were also shown. Later there was a demonstration of Exhaust Smoke Measurement.

Before leaving, members were given tea in the works canteen where the Secretary extended the thanks of the visitors to Perkins Engines for their interesting visit and for the hospitality afforded by the Company.

E. F. Raven
Hon. Secretary

LONDON & SOUTH EAST & CENTRAL SOUTHERN

Visit to Vauxhall Motors Ltd., Luton

A small party consisting of nineteen members and representatives visited the above works on 15th July. After coffee the programme commenced with a short film show. A tour of the commercial vehicle production works then took place in the morning, followed by lunch provided by Vauxhall Motors. The afternoon was devoted to touring the car production works. The visit proved to be extremely interesting and was appreciated by all the members of the party.

Visit to Southampton University

Sixteen members and representatives visited Southampton University on 1st October. The meeting took place in the afternoon at the Institute of Sound Vibration Research and commenced with a talk on environmental noise. This was followed by a tour of the laboratories to see some of the relevant work in progress and ended with a further discussion. The visit was very interesting and gave those attending an insight into the amount of research on noise problems which is being carried out at this University.

B. C. Upton
Hon. Secretary

NORTHERN

On the 3rd October 1975 the Northern Division held a General Meeting in the Five Bridges Hotel, Gateshead on Tyne, at which 83 members attended. On this occasion members were guests of Northern Gas and, on arrival, a welcome was given by Mr. J. Allan, the Director of Sales.

During the business meeting under the chairmanship of Councillor L. Poole, B.E.M., J.P., of Middlesbrough, the Honorary Secretary dealt with the constitution of the Northern Divisional Council, the draft for which had been approved by the Council of the Society and which was duly submitted to the meeting by the Chairman, when it was accepted without dissent.

The Honorary Secretary also reported on the resolution which had been passed at the previous meeting calling upon the Secretary of State for the Environment to treat the Northern Region as a special case in relation to Circular 171/74 (Rate Fund Expenditure 1975/76). He reported that the resolution had been considered by the Clean Air Council who, in reply, stated that "Paragraph 39 of the Circular was in no way intended as an absolute prohibition . . . The Clean Air Council were assured that the Department of the Environment would deal reasonably with any programmes submitted." The meeting expressed dissatisfaction with this reply and the Honorary Secretary was instructed to make further representations with the support of the Northern Economic Planning Council and, if necessary, the Northern Group of Members of Parliament.

The Honorary Secretary concluded with an account of the work of the Parliamentary and Local Government Committee extending throughout the previous year, in which connection he made reference to the successfull Spring Seminar which was held in Newcastle in March 1975.

After a general discussion and the approval of the Financial Statement 1974/75, a promotional feature was presented by Northern Gas. The first speaker was Mr. J. Allan, the Director of Sales, who spoke on "The Contribution of Natural Gas to Smoke Control Programmes". His talk was illustrated by a number of slides which dealt at length with many statistical considerations. He emphasised that no one fuel should or could supply 100% of the nation's total fuel requirements and he submitted that a fuel policy should be based upon the suitability and availability of fuels for particular purposes. Whereas petrol was eminently suitable for cars, electricity was outstandingly successful for lighting, gas was the obvious fuel for domestic heating as the alternatives were both wasteful and expensive. This submission was supported by a statistical table which gave the loss in production, utilisation efficiency, the overall efficiency and the pollution situation in relation to gas, solid fuel, electricity and oil.

Mr Allan was followed by Mr. Moulson of Northern Gas who gave a talk on customer service. Mr Moulson explained how Northern Gas were, now that the conversion to natural gas had been completed, concentrating efforts on customer service and he dealt at length with the installation of appliances, the repair situation, the servicing of appliances and the priority given to calls on their services. Spare part availability was dealt with and whilst Mr. Moulson explained how it was not possible to hold 100% stocks of more than a quarter of a million spare parts, it was possible to achieve a level of availability of 75% in stock. The speaker concluded his remarks by referring to the future of smoke control and emphasised that Northern Gas was confident that it could cope with any increased demand for appliances and installations that might arise with the extension of existing smoke control programmes.

The final part of the presentation by Northern Gas was a film entitled "The Air—My Enemy" which was received with approbation.

Following the film presentation an address was given by Mr. C. R. Cresswell, Principal Environmental Health Officer (Air Pollution and Noise Control) of the Department of Environmental Health, Newcastle upon Tyne, entitled "Smoke Control and the Present Economic Situation". Mr. Cresswell recalled that as a result of strictures and criticism on the lack of progress in the Northern Region, most local authorities had prepared and had embarked on accelerated smoke control programmes and, despite the restrictions implied in various Government Circulars, he held the view that on health grounds alone, a continuation of the smoke control activity in the Northern Region was justified. Mr. Cresswell argued that the present economic situation alone did not provide adequate reason for curtailing smoke control and, indeed, he put forward convincing arguments that it would be advantageous to pursue on economic grounds and without further delay smoke control programmes. Improved appliances and the better use of fuels arising from smoke control would result in a significant saving of energy and that any delay in pursuing smoke control would inevitably and eventually result in a much higher level of expenditure with the continuation of inflation. Mr Cresswell's closing plea appeared to be "go slow if one must, but don't stop".

The ensuing discussion was followed by pre-lunch cocktails and lunch at the kind invitation of Northern Gas. The thanks of the meeting to Northern Gas for the excellent arrangements and generous hospitality were expressed by the Chairman, Councillor L. Poole, and were received with acclamation by all present.

L. Mair
Hon. Secretary

AIR POLLUTION DETECTION

Wherever there is a known or suspected pollution of the atmosphere, a Casella air pollution sampler can detect it; dust, gases, chemicals, bacteria or spores in factories, foundries, mines or laboratories. Instruments are available for short or long period sampling for microscope, gravimetric or chemical analysis. All are simple to operate, and are compact, robust and reliable.

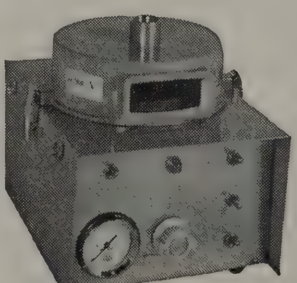
Casella instruments have been developed in co-operation with the Mining Research Establishment of the National Coal Board, the United Kingdom Atomic Energy Authority, the British Cast Iron Research Association and with leading British industrial hygienists. Several instruments are certified as intrinsically safe for use in explosive atmospheres.

Casella samplers are used widely throughout the world – setting the standards for comparison in many countries.

Facilities for the evaluation of samples are available from consultants.

Write for Air Pollution Catalogue 930/1-10.

The Personal Air Sampler provides the most reliable method of measuring airborne hazards to which a wearer is exposed during working hours. Samples are taken continuously for up to 10 hours. The instrument is compact, robust, lightweight and does not impede work. More than 10,000 are in daily use. Ask for leaflet 930/5.



The Bacteria Sampler draws air in known volume onto an agar surface rotating at one of three pre-set speeds. Models cover a flowrate of 30 litres and 700 litres per minute to permit sampling of variable concentrations. This unit is widely used by pharmaceutical, dairy product and food manufacturers. Ask for leaflet 930/7.

CASELLA LONDON

C. F. CASELLA & CO. LTD.
Regent House, Britannia Walk, London, N1 7ND.
Telephone: 01-253 8581.
Telex: 26-16-41.

CW CA4

Reader Enquiry Service No. **75103**

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INDUSTRIAL NEWS

Electric Melting of Grey Iron in the Motor Industry

The Ford Foundry at Leamington Spa has spent £2m on a major modernisation programme. On 31st October the last of three new electric melting furnaces was started up.

The foundry had relied on solid fuels, and two cupola stacks, each 80 ft high, had dominated the town's skyline. Although within legal requirements the emissions were not acceptable to the general public as the plant is sited on the edge of what is now a residential area and the company was anxious to anticipate legislation to control industrial emissions, while, at the same time, improving quality and profitability.

The new melting plant consists of three 31 tonne, 9 MVA mains frequency coreless induction furnaces, which together constitute the largest grey iron electric melting installation in Europe. Two furnaces have been in full operation since October 1974. Since two furnaces can supply the total factory needs, it is planned for only two out of three furnaces to be operational at any one time. This enables the third one to be relined or repaired when necessary without loss of production. Each furnace can produce four tonnes of grades 14 and 17 molten grey iron every 20 minutes.

The whole induction melting plant has been supplied by the Consortium BBC Brown, Boveri & Co., Ltd./GKN Birwelco (Uskside) Ltd. BBC Brown, Boveri who acted as the consortium leader supplied the three induction furnaces and other heavy equipment. GKN Birwelco supplied furnace controls and other auxiliary equipment. They were also responsible for a major part of the installation work on site.

Reader Enquiry Service No. **75104**

British companies collaborate over environmentally clean power generation

The collaboration between Babcock & Wilcox Limited and Combustion Systems Limited is an important step forward in fuel utilisation. As a result, fluidised combustion steam and power generation plant combining efficient fuel usage with environmentally clean operation will shortly be available on the commercial market.

It was announced in London recently that agreement has been reached between these two companies for participation in a joint enterprise to develop and commercialise British expertise in fluidised combustion, particularly in the field of steam and power generation. They are already engaged in the joint operation of a commercial-scale boiler plant employing this principle which has recently been commissioned at Babcock's works at Renfrew.

Babcock & Wilcox are known world-wide as technical and commercial leaders in the design and supply of plant for generation of steam and power from fossil and nuclear fuel. Combustion Systems Limited is Britain's foremost fluidised combustion development organisation, formed jointly by the National Coal Board, British Petroleum, and the National Research Development Corporation.

Fluidised combustion covers a whole family of techniques designed to produce energy by burning even the cheapest and dirtiest grades of solid or liquid fuel in a bed of inert particles kept in suspension. The process is simple and can economically combine high efficiency with environmental cleanliness. It has many advantages compared with conventional coal-fired or oil-fired systems. It reduces industry's demand for high grade fuels because it can use virtually any fuel—liquid or solid—including those with high ash or sulphur content—amongst them heavy oils. Atmospheric pollution is decreased because it produces stack gases with minimal sulphur dioxide and oxides of nitrogen.

The technique already features in development plans for the wider use of coal and other solid fuel resources in the United States and Canada where Combustion Systems Limited have been working with local interests for some time. Applications will extend to the largest of power stations and involve systems in which both gas turbines and steam turbines are interlinked. Large fluidised combustion installations for central power stations may take a decade to develop, but industrial boiler plant can now be produced and coal-fired gas turbine plant should be a reality in the near future—and there is no other practicable way of directly firing gas turbines with solid fuels.

The new organisation will give potential customers access to the research facilities of laboratories associated with Combustion Systems Limited—such as the British Coal Utilisation Research Association, the NCB Coal Research Establishment and the BP Research Centre—together with the engineering expertise of Babcock & Wilcox and the development capabilities of their Renfrew research organisation, now supplemented by the fluidised boiler installation.

Reader Enquiry Service No. **75105**

AAF-Ltd. receive an order for £1·5m.

AAF-Ltd. recently announced receipt of an order in excess of £1·5 million for an air pollution control system from the British Steel Corporation.

AAF will provide a 24-compartment AMERtherm fabric collector, ductwork and air handling equipment on a turnkey basis for four electric arc furnaces at British Steel Corporation's, Special Steels Division, Stockbridge Works, Sheffield.

The AAF equipment will help the British Steel Corporation upgrade existing air pollution control systems already in operation at the Stocksbridge Works. The canopy hoods, mounted over 80, 100 and two 140-ton furnaces, will provide melt shop ventilation during furnace charging, melting and pouring operations. Exhaust gases are to be ducted to the AAF AMERtherm fabric collector for removal of particulate matter before venting the clean gases to the atmosphere. The fabric collector will be designed to handle two million cubic feet of gases per minute. Startup of the AAF system is scheduled for mid-1976.

The Stockbridge Works is a specialty steel mill which produces 580,000 tons of various alloy steels each year. British Steel Corporation uses similar AAF air pollution control systems at various other steelmaking facilities.

Reader Enquiry Service No. **75106**

AVS-Hobbs electric vehicle development

The cost of hydro-carbon based fuels and their effect on the country's balance of payments plus the increasing awareness of the pollution factor associated with the internal combustion engine have contributed to the current interest in electric vehicles.

One of the most promising markets is for light delivery vans operating over a limited range. Research shows that up to 40% of national van fleets are operating at under 40 miles per day and could go electric immediately. For long-haul work, however, the electric vehicle is not yet a viable proposition owing to the sheer bulk of batteries required.

The introduction as a fully-proven unit of the AVS-Hobbs torque converter with high-speed shunt motor enables much more efficient use to be made of current technology batteries. Thus the immediate market for electric vehicles is extended from the milk float trade to the very large area of van operators with a usage of between 50 and 80 miles per day. Its advantages include overall cost, operating cost, performance and gradeability, range and reliability.

The system is based on the Hobbs torque converter, winner of the Richardson Gold Medal as the Best Invention of 1972. It is patented in all major countries of the world, including USA, Japan, Australia, Canada and the Common Market countries.

The cost of the motor and controller required by any electric vehicle forms approximately 25% of the total new vehicle cost. The AVS system is claimed to save up to 35% of this cost.

A 5 cwt payload van equipped with the AVS system accelerates to 45 mph, climbs a 25% (one in four) gradient when laden and runs between 50 and 80 miles on a single charge, using current technology batteries.

The motor is controlled entirely by standard contactor switches which are easily maintained by auto trained mechanics at a fraction of the cost of electronic systems. Additionally the AVS system under acceleration draws only about one-third of the maximum motor current needed in equivalent electronic systems. This increases the range in multi-stop driving since heat losses in the motor windings are reduced by a factor of nine. The reserve of motor power always available also enables speed to be maintained on undulating roads.

The incorporation of a one-way clutch on the output shaft locks the converter on overrun when the brakes are applied, so regenerating energy back into the batteries.

In addition to the light van market there are also exciting possibilities for the AVS Hobbs system in electric lift trucks.

Reader Enquiry Service No. **75107**

New electronic total air cleaner

The Scandair SD-75 is a small, light weight, wall fitting electronic Air Cleaner with a Disposable Collecting Cell. Using less than a 25 Watt light bulb, this unit will remove all airborne pollutants such as Tobacco Smoke, Pollen, Dust, Ash and Lint, etc., and recirculate back into the room up to 70 cubic feet of cleaned air per minute.

The SD-75 is completely insulated and among the many inbuilt safety features are, Three position On/Off switch, 'mains on' neon indicator, both live and neutral wires have safety interlock isolating switches and it is protected with Two 1 Amp fully enclosed fuses.

The unique low cost plastic collecting cell is easily replaced—just lift out the old cell and replace with a new one. There are no electrical connections to be made during this operation and the new cell under average conditions should last between 6-9 months.

Reader Enquiry Service No. **75108**

New series of industrial grade sound level meters

With the growing awareness of noise pollution and the increasing rate of inflation, Castle Associates have introduced a new low cost line of industrial grade sound level meters. Called the 18 series it initially consists of two models, the CS 18B and the CS 183A with new models in development.

The CS 18B is a simple sound level meter, reading in dB(A) intended to be used for measurement in the field of industrial noise and general survey work. Great emphasis has been placed on ease of use and reliability, and to this end a very rugged ceramic microphone has been used and the meter has been protected by mounting inside the steel case.

For economic reasons, controls are kept to the absolute minimum consistent with British Standard performance and the unit has an exceptionally long battery life, in the region of 200 hours. The CS 183A has, in addition to the basic functions of the CS 18B, "C" weighting as well as "A" and a peak hold and memory circuit. Thus the maximum level occurring in any noise event can be stored. This also means that the sound level meter can be used semi-unattended. The CS 183A has been designed for police forces in the USA and continental Europe, and has the same rugged design features as the CS 18B.

Both the CS 18B and CS 183A are available in an attractive executive case, foam lined to protect the units. A calibrator, type CA 13 is included in this kit, together with a wrist strap and windshield with all the other small accessories required for simple and easy measurement.

Reader Enquiry Service No. **75109**

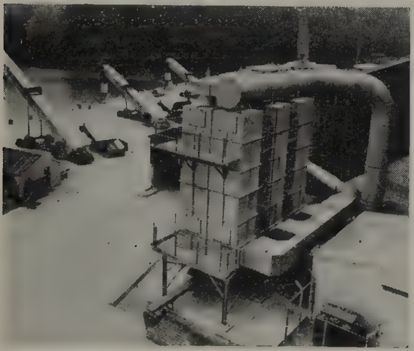
Controlling china clay dust

Illustrated is part of a sophisticated dust control system which is used to collect the dust generated when lorries are being loaded with china clay by mechanical shovels.

The dust control installation was supplied by the Midac Dust Control Division of Carter Industrial Products Ltd, Birmingham, to the Fowey Plant of English Clays Lovering Pochin & Co Ltd, the china clay producing subsidiary of English China Clays Ltd.

The dust control equipment comprises two identical plants situated at each end of the company's clay store, each plant comprising a Midac type HT3 filter unit and seven dust control hoods. The equipment is designed such that three of these seven hoods can be in operation at any one time and consequently up to six lorries can be loaded from the store simultaneously.

The special-purpose hoods are arranged such that air is extracted from them only when a lorry is in position for loading. The hoods have been designed so that exhaust air is taken from the side opposite the mechanical shovel where the major dust plume is generated.



The Midac type HT3 fabric sleeve filter units employed in the installation—one of which is shown in the picture—are each capable of handling a volume of 45,000 cfm with an air to cloth ratio of 3·75 to 1.

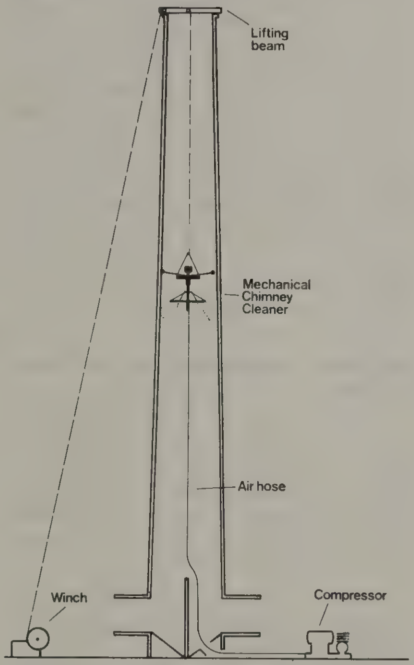
Each filter is approximately 27ft long, 13ft 6in wide and 18ft 8in high and comprises three separate compartments housing 7in diameter cotton filter sleeves. The filter units are fitted with mechanical shaking gear which is automatically sequence controlled to give shake down of each compartment whilst the unit as a whole is in continuous operation.

The collected dust is transported from the filter unit via a screw conveyor to a convenient point for removal from the plant.

Reader Enquiry Service No. **75110**

New Chimney Stack Cleaner

A new mechanical chimney cleaner which has substantial operating and environmental benefits has been developed by Jordan Engineering Ltd, in co-operation with the Central Electricity Generating Board. The new machine overcomes the problems of existing mechanical and automated methods of cleaning the inside of chimney stacks in the power, processing, steel and other important industries.



Previous methods have required either long shutdown periods or posed other practical difficulties producing uncertain results at a very high cost. Hand brushing, for example, has been widely used but needs considerable manpower and a minimum 7-10 days with the chimney out of use. An alternative method is water washing which requires a high volume of pressurised water with the danger of acid, sludge and the possibility of aggravating weaknesses in the chimney structure.

Often these difficulties have resulted in the cleaning of chimneys being neglected. This neglect means that after a time the dirty stack will expel pollutants into the atmosphere; it can also help to reduce the working life of the flues.

The new machine represents a radical alternative to previous chimney cleaning methods. Prototypes have been developed jointly with the CEGB and these have been thoroughly tested for up to three years.

The Jordan 'Rotaflail' works on a very simple principle. Rotating chain flails mounted on a circular frame and driven by compressed air are winched down the inside of the chimney. Stability is maintained by a tripod structure to which guiding wheels are attached. As they go round the chain flails remove the accumulated deposits from the chimney wall.

Once the machine has been set up initially, operation is very rapid, and the cleaning is completed within a few hours. A minimal shutdown time (less than two days) is required.

Other advantages of the system: no damage is done to the brickwork of the chimney; very little manpower is required and none inside the chimney itself; the device is fully adjustable to cater for tapering chimneys.

Power is provided by compressed air which drives three Atlas Copco air motors (type MZC42G22P1). This is fed to the gear box.

Telescopic steady legs fitted with rubber tyred wheels stabilise the machine and the chain ring is driven by the output shaft of the gear box. Lifting gear is attached to the central tubular fabrication to lift the machine and further wires are fixed to the steadying legs to support them.

Reader Enquiry Service No. **75111**

New design for Pnu-Jet

Nailsea Engineering, of Blackburn, have taken yet another step forward in the design of their Pnu-Jet bag filters, which has proved to yield a considerable increase in the efficiency and performance of their installations.

Nailsea bag filters have always incorporated the new widely-accepted reverse-pulse system for the cleaning of the bags, which means that there are no moving parts in the gas stream and hence minimum wear and tear. In round terms a jet of high-pressure air is introduced momentarily at set intervals into the bags, creating a reverse flow together with a shock wave, which has the effect of discharging the build-up of dust on the dirty side of the bags.

The latest Nailsea development uses the well-known venturi principle for the jet nozzles to reduce frictional losses in this reverse burst of cleaning air—with consequent higher energy release. Removal of the dust build-up is hence more thorough and the performance of the filter unimpeded.

Reader Enquiry Service No. **75112**

New Instrument to Measure Air Pollution

A new instrument which it is predicted will be widely used for plotting the equality of air over industrial and urban areas has been introduced by Hepworth Electronics. The integrating nephelometer measures solid particles contained in a continuous air sample and thus provides a real-time record of particulate contamination and its contribution to reduced visibility. Because it operates unattended and can be mounted in any attitude, the instrument is equally suitable for fixed mounting or for mobile use—such as in a car or light aircraft. It can for instance be used to produce a three-dimensional pollution map for a particular area to show the normal direction of travel, how quickly the pollutents dissipate, and pockets where they persist longer. It is also used as a static instrument in research projects or for continuous monitoring of emission on a particular site.

The integrating nephelometer uses light scattered by the particles to determine the level of pollution. The air sample is illuminated and light scatter detected by a photo-multiplier tube. The resultant signal is compared with a reference from another phototube looking at the lamp and the result is displayed as the extent of visibility assuming that the atmosphere everywhere is identical with the sample in the tube. A unique feature of this instrument as against the human eye is that it can measure the contribution that humidity makes to reduced visibility. Water droplets form around solid particles when relative humidity exceeds 70%, increasing light scatter. The nephelometer can be fitted with a heater to bring the RH of the sample below this level and thus to provide a reading for solid particles only. The integrating nephelometer was developed by Meteorology Research Inc of California who have been prominent in the field of atmospheric studies in the US for the past twenty years. UK agents are Hepworth Electronics.

Reader Enquiry Service No. **75113**

New Toxic Vapour Area Monitor

A new multi-point toxic vapour area monitor designed for automatic sampling and measurement of ambient air is available from Techmation Ltd. The Wilks MIRAN 201 Toxic Vapour Analyser can be sensitised to monitor any one of over 300 toxic vapours at the compliance levels established by OSHA (The Occupational Safety and Health Administration in the USA). The instrument sequentially monitors as many as 15 remote locations up to 500 feet away, and prints out vapour concentrations in parts per million as well as sample location and time of day on a digital printer. Adjustable high level alarms and malfunction indicators are included. All of this information is needed to meet OSHA compliance record-keeping requirements.

The single wavelength infra-red measurement system used in the MIRAN 201 permits a high degree of selectivity, thereby reducing the possibility of interference from other vapours that may be present in the atmosphere being measured. It is easy to operate, needs little operator attention and no services other than power. The MIRAN 201 represents a significant advance in instrumentation for permanent environmental monitoring stations.

Reader Enquiry Service No. **75114**

Portable car exhaust extract fan unit

Garages will have to conform to the tougher laws in the 1974 Health and Safety at Work Act. One of the clauses relates to the emission of dangerous fumes, such as car exhaust gases.

Fixed exhaust extractors can be very expensive and difficult to install, particularly in existing garages. Moducel of Stoke-on-Trent who are fan and ventilation engineers have developed a portable unit with flexible tubes. It is designed for tuning and normal testing of cars, either with single or twin exhausts, and it does not affect the engine performance. It has been well tested in the field and should fill a real need at a very reasonable price.

Reader Enquiry Service No. **75115**

New fume incinerators aid pollution control

A new range of pollution control equipment from combustion engineers John Thurley Ltd. of Harrogate consists of standardised gas-fired incinerators designed to destroy fumes from a wide variety of food processing and industrial plant.

The CF Incinerator incorporates a Maxon 'Combustifume' burner mounted in a refractory-lined incineration chamber. This burner has been specially designed so that all contaminated fume is forced into contact with the flame to ensure rapid mixing and uniform heating to the incineration temperature.

Nine standard units are available, ranging from 500,000 Btu/hr to 10,000,000 Btu/hr burner heat duty. Fume flow rates from 250 s.c.f.m. to 10,000 s.c.f.m. can be handled according to inlet temperature, which ranges from ambient to 1,000°F.

Incinerator sizes vary from 10 feet long by 4 feet diameter to 10 feet long by 7 feet diameter. Each unit is supplied complete with a full set of controls for safe and automatic operation and all units are fully pre-packaged to ensure fast and easy erection on site.

The requirements for utilising these standard incineration units are:

(a) Fume flow rate must be constant.

(b) Fume must contain at least 16% oxygen by volume.

(c) Fume should be basically air with impurities comprising compounds of carbon, hydrogen and oxygen —and the fume must not be corrosive.

(d) The fuel used should be either natural gas or propane.

(e) The units are designed for indoor installation in a non-hazardous environment.

The CF Incinerator range has been designed to destroy fumes from such food processing plants as fish fryers, offal boilers, fish meal dryers, coffee roasters, corn product dryers, meat smokehouses and fat renderers. In manufacturing industries the equipment can deal with fumes from solvent-based paint drying ovens, plastics crating dryers, glass-fibre curing ovens, lithographic ovens, textile dryers and wire enamelling ovens. Fumes from such process equipment as solvent de-greasing plants, scrap lead melting furnaces and oil-quenching baths can also be incinerated.

Reader Enquiry Service No. **75116**

Blasting away a nuisance

The absence of dust during the blast cleaning last month of an old mill at Milnsbridge, Huddersfield, has impressed Kirklees health officials. They had come with the chairman of the Kirklees Environmental Health Committee, Coun. John Mernagh, to watch a demonstration of wet, as opposed to dry, grit blasting given by industrial cleaners McAlister using the Kleenblast system.

The advantages of this system—developed by Hodge Clemco Ltd, the blast cleaning equipment manufacturers of Handsworth, Sheffield—is that it lays the dust created by blasting and prevents atmospheric pollution. The water used in the operation also removes ingrained salts and chemical residues from the cleaned surfaces.

A large number of complaints had been received about the nuisance of drifting sand. "The process we have seen," Councillor Mernagh said, "eliminated this nuisance in which blowing sand containing silica was a health hazard." Kirklees Council have said they would like to see national action to abate the nuisance caused in building cleaning. Whilst they are powerless to take any legal action, they favour the setting up of local standards of approval for contractors.

Reader Enquiry Service No. **75117**

CLEAN AIR

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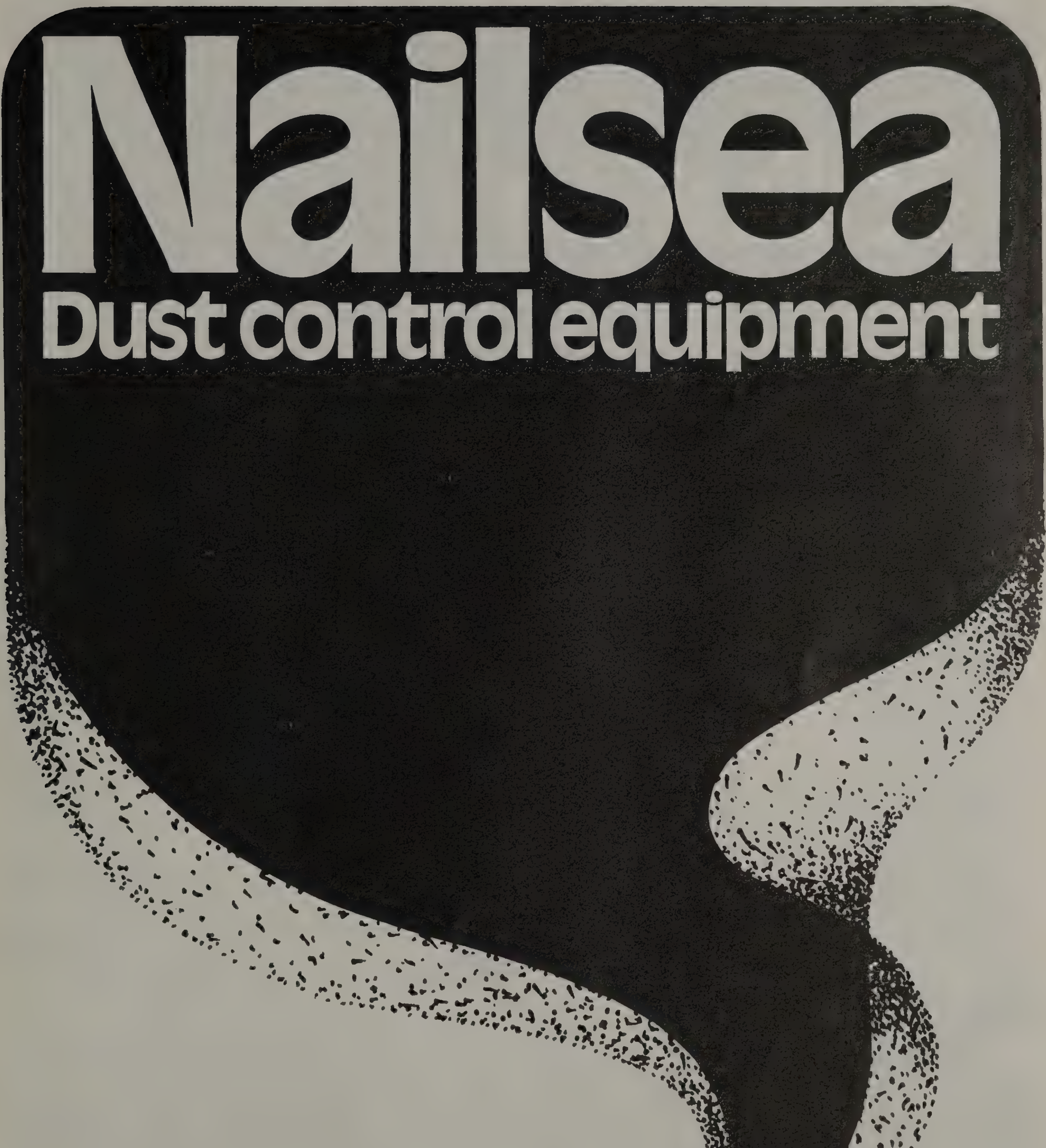

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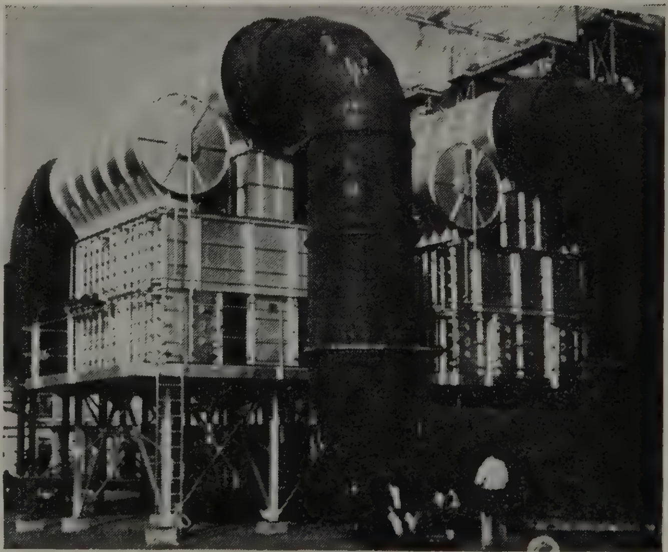

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CLEAN AIR

SPRING 1976
VOL. 5 NO. 21

The Case Against Unrestricted Access to National Survey Data
M. P. Paterson

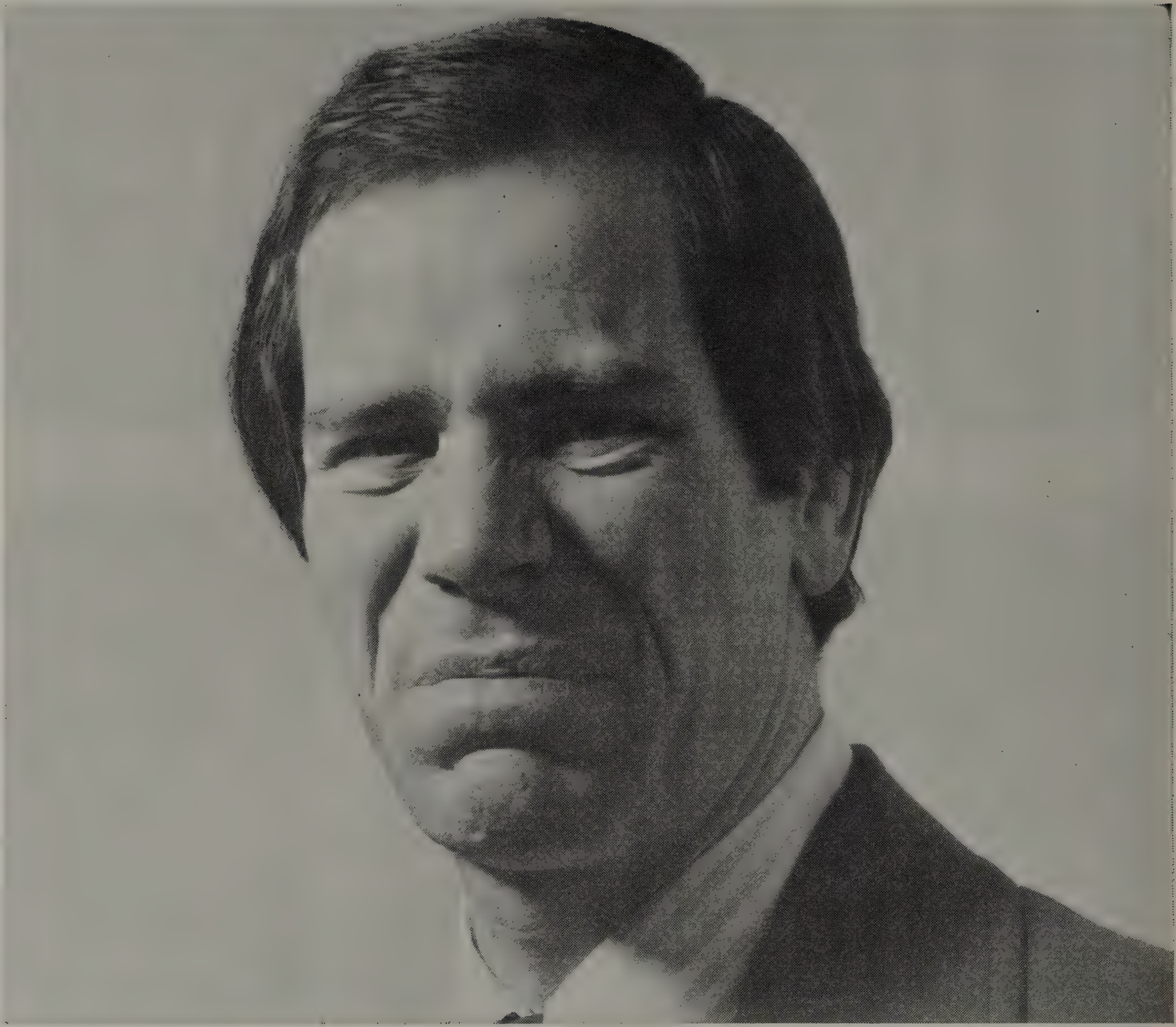
International News

Book Reviews

The Potential Use of Low Temperature Matrix Isolation Infra Red Spectroscopy for the Determination of Airborne Amines
D. F. Ball & C. J. Purnell

Smoke Control Areas

An Air Pollutant Emission Inventory for the Greater London Area
Dr. D. J. Ball



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CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

Vol. 5 No. 21 **Spring 1976**

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Diary of Events

22nd April (Thursday)
Annual General Meeting of East Midlands Division
Lincoln

11th May (Tuesday)
Copy date for Summer issue of 'Clean Air'.

13th May (Thursday)
London, South East & Central Southern Divisional Visit to London Brick Co Ltd, Stewartby Works.
Bedford

a.m. Meeting of Divisional Secretaries London.

p.m. General Purposes & Finance Committee Meeting.
London

20th May (Thursday)
p.m. Meeting of the Council of the Society.
London

26th May (Wednesday)
Annual General Meeting of London, South East & Central Southern Division. Speaker: Mr. Brian Joyner of ISC Chemicals Ltd.
Hobart House, London.

25th June (Friday)
Meeting of the Clean Air Council.
London

16th September (Thursday)
London, South East & Central Southern Divisional Visit to Chloride Automotive Batteries Ltd.
Dagenham

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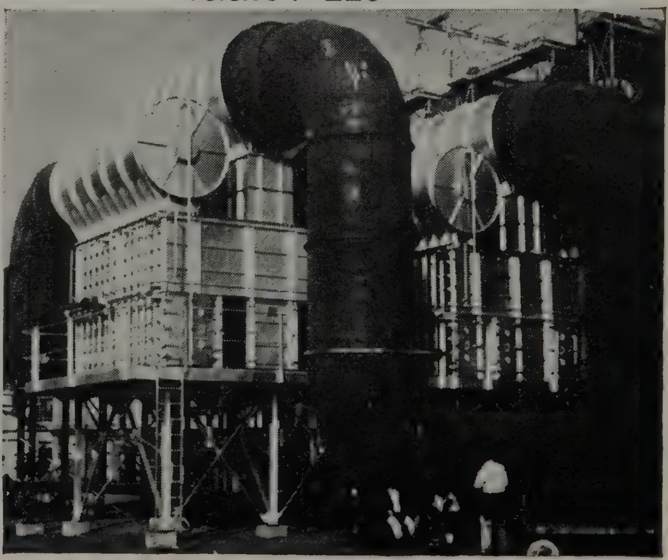


Reader Enquiry Service No. 762

"This most excellent canopy, the air"

CLEAN AIR

Fifth Report of the Royal Commission on Environmental Pollution, Air Pollution Control: An Integrated Approach

The long awaited Report of the Royal Commission was published on 15th January, 1976 and in all makes no less than ninety four recommendations ranging from those dealing with domestic smoke control to those concerned with planning.

Perhaps the most interesting recommendation is that a central inspectorate, to be known as H.M. Pollution Inspectorate, or HMPI, should be established and this should take over the existing staff and responsibilities of the Alkali Inspectorate and should apply an integrated approach to difficult problems of industrial pollution at source, whether these affect air, water or land. This is a far reaching proposal but the concept is one that is not new to those intimately concerned with the control of air pollution who for long have taken the view that air, water and land, in terms of pollution, are indivisible. So this recommendation is certainly welcomed by clean air interests; but it is too early to say what the reaction of the water authorities and waste management authorities might be. At the same time, there is little doubt that to many industrialists, the idea of one central inspectorate with whom they can deal on all matters of pollution will be a great advantage.

Whether or not the new central inspectorate is established as recommended remains to be seen; but the Royal Commission are in no doubt that the transfer of the Alkali and Clean Air Inspectorate to the Health and Safety Executive on the 1st January 1975 was a mistake which should be rectified. The Commission would like to see the Alkali Inspectorate transferred back to the Department of the Environment.

While recommending that more specific attention should be paid to the establishment of air quality guidelines and that local authorities should adopt air quality targets using such guidelines, the Royal Commission are quite clear that the principle of air pollution control should continue to be the best practicable means. The Commission are also of the opinion that control of industrial air pollution should continue to be shared between the local authorities and the central inspectorate and that there should be close liaison and communication between the two. In the Report it is emphasised that "there is . . . a real need for co-operation between local authorities and the inspectorate, whose roles are in some ways complementary. Local Authorities through their Environmental Health Officers offer greater numbers, local knowledge, accessibility to the public and, generally, the ability to respond quickly to complaints; the Alkali Inspectors their specialist expertise. In a few of the areas we have visited . . . we have seen working relationships which, if reproduced throughout the country, might make this aspect of our study superfluous. In other areas the position is very different".

As regards the provision of control between the central inspectorate and local authorities, it is recommended that unless there are grounds for control by the central inspectorate, local authorities should control all those works which lie within their technical competence.

The Report makes a few suggestions with regard to domestic smoke control, the principal ones being that decisions about where smoke control is needed should continue to be made by the local authorities and that sulphur content should be taken into account in considering the approval of fuels for use in smoke control areas.

So far as planning is concerned, the local authorities, aided by air quality guidelines, should consider determining the total pollution capacity for a site against which applications for the development could be cumulatively assessed. Pollution policy should be embodied in structure plans and developed in subject plans.

The Report is eminently readable and well argued and everyone concerned with clean air should read it for themselves. Some may have reservations about the retention of the principle of the best practicable means; others may be unsure about the establishment of air quality guidelines for certain pollutants and the encouragement of local authorities to adopt air quality targets. These are matters which will have to be resolved but, with give and take on both sides, it seems not impossible for the best practicable means to be used to achieve the attainable with the guidelines as the goal.

There will undoubtedly be objections from some sources about the establishment of a central inspectorate and one of the arguments that may be used will be that this is creating another large body. Strangely enough, some of the objections already raised on this count have come from those who have for years been saying that the Alkali Inspectorate was far too small and should be enlarged. The Royal Commission do not envisage that the new inspectorate will be a very large body; if such a body can achieve a greater control of pollution and a better environment, then its establishment and cost would be fully justified.

The Society itself and indeed many members of the Society, gave written and oral evidence to the Royal Commission and it is gratifying to see that some of these suggestions made have been taken up by the Commission. At the forthcoming Edinburgh Conference, on the morning of Wednesday, October 13th next, the Chairman of the Royal Commission, Sir Brian Flowers, will present the Report to Conference and explain the background to their findings and recommendations. These recommendations could have far reaching effects on the control of pollution in this country and in other countries of the E.E.C. This session at the Edinburgh Conference will afford an opportunity to all to bring themselves up to date with a changing situation and the possible legislation of the future.

43rd Clean Air Conference

Edinburgh

11-15th October 1976

OPENING SESSION - MONDAY, OCTOBER 11

20.30
Civic Welcome by the Lord Provost of Edinburgh
Formal Opening by Lord Kirkhill, Minister of State, the Scottish Office
Presidential Address by Professor P. J. Lawther

SESSION TWO - TUESDAY, OCTOBER 12

NOISE
10.00
Noise as an Air Pollutant
Dr. A. J. Crosbie, Department of Geography, University of Edinburgh

Industrial and Local Authority Approach to Neighbourhood Noise
J. H. Richardson, Senior Consulting Engineer, Acoustic Technology Ltd

SESSION THREE - TUESDAY, OCTOBER 12

SMOKE CONTROL
14.30
A Review of the Present Situation and the Way Ahead
W. J. S. Batho, Department of the Environment

Smoke Control in an Industrial Area: Experience in North East England
L. Mair, Chief Environmental Health Officer, Newcastle upon Tyne

SESSION FOUR - WEDNESDAY, OCTOBER 13

THE CONTROL OF AIR POLLUTION
10.00
The Findings and Recommendations of the Royal Commission on Environmental Pollution
Sir Brian Flowers, FRS, Chairman of the Royal Commission

SESSION FIVE - THURSDAY, OCTOBER 14

POLLUTION - URBAN & RURAL
10.00
The Health Implications of Environmental Pollution
Professor M. Howe, Strathclyde University

The Control of Pollution in Rivers, 1876 to 1976; and the Way Ahead
D. Hammerton, River Clyde Purification Board

OPEN SESSION - THURSDAY, OCTOBER 14

SOLAR ENERGY
14.30
A Panel of Specialists will discuss all aspects of Solar Energy relative to present and future possibilities. Films and demonstrations will form part of the presentation. The Panel will be prepared to answer questions on any aspect of this subject.

SESSION SEVEN - FRIDAY, OCTOBER 15

WASTE DISPOSAL
10.00
The Disposal of Toxic and Radio-active Wastes
Dr. D. H. Sharp, The Society of Chemical Industry

TECHNICAL VISITS

Wednesday Afternoon, October 13

1. Grangemouth Oil Refinery
2. Rexco (Scottish) Ltd, Comrie Colliery
3. The Caledonian Distillery, Edinburgh
4. The Fountain Brewery, Edinburgh

SOCIAL PROGRAMME

Tuesday Morning, October 12

5. Coach Tour of Edinburgh

Wednesday afternoon

6. Tour of the Scott country

Thursday morning, October 14

7. Edinburgh Castle and St. Giles Cathedral

CONFERENCE RECEPTION

Tuesday, 20.30 - 23.59, October 12
Reception and Dance at the Assembly Rooms

Reader Enquiry Service No. **763**

An Air Pollutant Emission Inventory for the Greater London Area

by

Dr. D. J. Ball

Environmental Sciences Group, Scientific Branch, Greater London Council

1 The Concept of an Emission Inventory

Air quality in Greater London, as in the rest of the UK, is traditionally studied by the monitoring of selected pollutants at a network of National Survey sites and a few other specialised sites operated by Central and Local Government bodies and in some cases by industry. Whereas this approach to air quality assessment provides a valuable insight into existing atmospheric conditions, the data are inadequate for forward planning purposes. For cost effective policies on air quality to be developed it is essential to establish a connection between the ambient concentrations of pollutants and their sources. This involves a series of steps. The first is to establish an emission inventory, or directory of sources of air pollution, together with the type and quantity of pollutants emitted and the emission characteristics for each source. This information can then be used in an air pollution dispersion model, which need not be elaborate, to predict ground level concentrations. The next step is to use the model to explore the implications of various policy options, which will, of course, involve among other things comparison of predicted ground level concentrations with appropriate air quality guidelines.

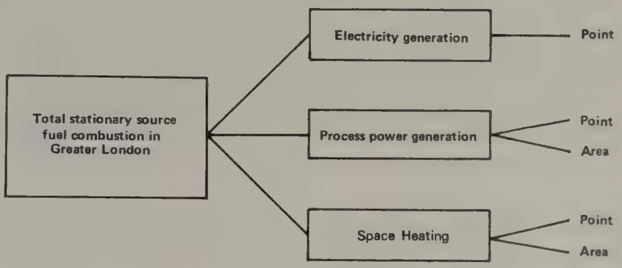
An example of the combined application of an inventory and dispersion model occurs in the City of Toronto's evaluation of air pollution resulting from various proposed district heating schemes (1). Factors such as cost, heat demand, aesthetics and size formed the overall study and combined with the air pollution modelling results in the final considerations of the optimum district heating schemes. An example closer to home is the Firth of Forth study (2) aimed at assessing the impact upon air quality of a new power station and of expansion of industry, anticipated as a result of the exploitation of North Sea oil.

This paper deals with what is in many ways the crucial step in any air quality scheme, and that is the development of an emission inventory. Inventories have been established for many of the larger conurbations in W Germany, The Netherlands, Scandinavia and Italy, and further afield in the USA, Canada, Japan and Australia. However, in the UK few attempts have been made to relate ambient air quality to emissions, and those that have concerned Sheffield (3) and Reading (4), which are smaller and less complex. Apart from the one described here, the only other in depth emission inventory for planning purposes in this country is that being established by the Warren Spring Laboratory under contract to the Scottish Development Department for the Firth of Forth region (2).

2 Strategy for the Greater London Emission Inventory

Atmospheric emissions result to a large extent from the combustion of fuels by stationary and mobile sources for electricity and steam generation, space heating and propulsion. Other important sources of emission are from industrial processes and incineration. A comprehensive emission inventory would seek to establish the type and rate of emission of all primary pollutants from each of these source categories. Primary pollutants are taken to include SO_2, smoke, hydrocarbons, NO_x, CO and heavy metals in this instance, although others may be added as required. Clearly there are so many sources that each cannot be surveyed individually, and a compromise has to be made by treating individually only large sources. Smaller sources are considered in groups called 'area sources', and their emissions are evaluated statistically.

Figure 1a Subdivision of stationary sources into five categories



This report is concerned mainly with sulphur dioxide as this is a primary pollutant whose annual mean for Greater London is well above the GLC guideline concentration (5), and which will provide suitable experience for inventories of other pollutants. However, consideration for other pollutants is not excluded as much duplication of effort can be avoided by adoption of a unified approach from the outset.

2.1 Sources of Sulphur Dioxide

The sulphur dioxide in most urban environments derives almost exclusively from the oxidation of the sulphur content of coal and fuel oil during combustion. This is true of Greater London. Contributions from gas-fired plant are negligible. Similarly it has been estimated that automotive sources account for only ~1% of Greater London's total sulphur dioxide emission (6).

Figures 1a and 1b illustrate how these sources can be usefully sub-divided into the three categories of electricity generation, process power generation, and space heating. The value of this sub-division is that each of these source categories will consume fuel according to well-established patterns as shown in Figure 1b. Thus fuel consumption for space heating applications will vary with the season, whereas process fuel consumption would be approximately constant.

The sources are further divided into essentially large emitters, called 'point sources' and smaller emitters, which together with other smaller emitters, form 'area sources'.

2.2 Analysis of Point Sources

Point sources of sulphur dioxide have been defined, for Greater London, as those sources with an annual emission of 60 tons (61×10^3 Kgms) or more, which generally corresponds to a boiler capacity in excess of 25 MBTU/hr, or to an annual fuel consumption in excess of 200,000 gals of fuel oil or 1,500 tons of solid fuel (7). Since such large emitters are likely to have a substantial effect upon London's atmosphere it is necessary to obtain detailed information from each about fuel consumption and fuel type, and about emission characteristics, such as stack height. This can be achieved by the use of questionnaires mailed to the appropriate locations.

A test survey has been carried out in the Borough of Hammersmith (7), in co-operation with that Borough's Environmental Health Department, to assess the effectiveness of the method. Emitters of various sizes were surveyed by questionnaire. Although the Greater London survey would be restricted to point sources as defined earlier, it was considered worth while in this instance to examine the fuel use patterns of the full range of boiler sizes down to 1·25 MBTU/hr. Most emitters were readily identified by the Environmental Health Department of Hammersmith from their intimate knowledge of the area. Other possible sources were located by examination of 1:2500 maps, and a list of 88 names and addresses drawn up. The list included a variety of types of user ranging from schools, cinemas, small industrial, commercial and office buildings, to large industries, hospitals and a power station. The response to the survey was very encouraging in both the information content of the completed questionnaires and the number of questionnaires returned.

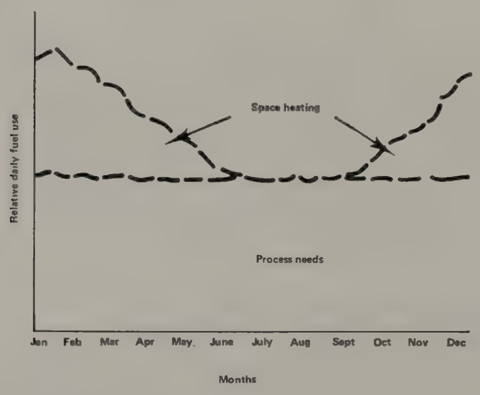


Figure 1b Relative seasonal and daily variation in fuel use for space heating and process work

2.3 Analysis of Area Sources

Although point sources may contribute the greatest percentage of the total SO_2 burden, area sources generally emit their pollutants from shorter chimney stacks and with lower buoyancy, and consequently account for a disproportionate part of the local ground level concentration. It is therefore necessary to consider these sources carefully where local effects are important. Two methods are available, the first of which entails the following steps:

(a) Divide Greater London into 1Km × 1Km squares as defined by the National Grid.

(b) Divide the area sources into sub-categories such as domestic, small industrial, commercial, etc.

(c) Determine the amount of each area source sub-category within each 1Km × 1Km grid square. (This information is already available in the form of the Greater London Land Use Survey, in which floor areas of industrial premises, shops, offices, etc, are listed for each grid square (8).)

(d) For each fuel, apportion the totals for Greater London, less that used by point sources, to each category and, finally, to each grid square. (Total fuel consumption figures for the Greater London area were published by the Department of Energy until 1973 (9).)

As an illustration, if the annual consumption of coal by domestic users in Greater London is X tons, and there are N dwelling units in Greater London and n in a particular grid square, then on an approximate basis one can allocate (nX)/(N) tons/annum to domestic users in that area. Clearly a more refined knowledge of fuel supplied in Greater London than reference (9) allows would improve accuracy. In view of this, all major fuel and power suppliers have been approached for more precise information.

The second method which has been investigated seeks to establish empirical relationships between the size of each category of area source within a grid square (eg, floor area or site area) and its fuel consumption. This has already been done for office buildings, where the annual consumption of fuel for space heating has been determined per square metre of office floor space (7). This was achieved by use of emission inventory data collected during the last few years by the Department of the Medical Officer of Health for the City of London. Similarly the annual fuel consumption/unit floor area can be estimated for other categories.

2.4 Other Sources of Sulphur Dioxide

Sulphur dioxide is emitted also during certain types of process work, such as sulphuric acid manufacture and smelting. Where such processes are identified in Greater London it will be necessary to relate the processing speed to the emission rate of sulphur dioxide by use of an ' emission factor '—

Sulphur dioxide emission rate = (process rate) × (emission factor).

Emission factors can be calculated only with a detailed knowledge of the processes involved. Alternatively, emission data may be available from the process operators themselves.

2.5 Inventories for Other Pollutants

Inventories would be desirable also for pollutants such as smoke, NO_x, CO, hydrocarbons and heavy metals. The stationary sources identified for SO_2 emissions are also emitters of particulates and NO_x, and to a lesser extent CO and hydrocarbons. Emission factors are available for computation of emissions of these pollutants once the basic boiler size and fuel consumption data are available (10). For complete stationary source inventories of these additional pollutants it would also be necessary to take account of process losses, waste incineration producing primarily particulates, and evaporative hydrocarbon losses.

The pollutants NO_x, CO and hydrocarbons are emitted in large quantities also by internal combustion engines. To produce a mobile source emission inventory is itself a major undertaking, but again one to which consideration must be given. Fortunately extensive data on traffic flow are already available for the Greater London area (11). From this data the number of vehicle miles travelled/grid square is obtainable. Once appropriate emission factors for British vehicles are determined the emissions can readily be calculated.

$$\text{Emission/km grid square} = \sum_{\text{Vehicles types}} \left(\text{Vehicle miles travelled/km grid square}\right) \times \left(\text{emissions/vehicle miles travelled}\right)$$

3 Conclusion

The immediate conclusions and status achieved by the work so far are as follows:

(a) A general approach to compiling an emission inventory for Greater London has been explored in some detail for sulphur dioxide emissions. Procedures appropriate to this area have been developed and sources of information identified and contacted such that a comprehensive inventory for this pollutant is now a feasible objective.

(b) Key factors in the approach—such as the response to questionnaires, and the accuracy and scale of fuel usage figures available—have been tested and the results found most encouraging.

(c) A definition of point sources in the context of Greater London has been determined from practical experience, and methods of identification of such sources investigated.

Following the success of the explanatory investigations, a full-scale London-wide inventory is now planned for sulphur dioxide and, eventually, other pollutants. The help of the Environmental Health Departments of each of London's Boroughs is to be sought with a view to identifying large sources of emission.

Acknowledgments
It is a pleasure to offer thanks to the Environmental Health Department of the London Borough of Hammersmith, particularly Mr J. J. Beagle for close co-operation on the point source pilot survey, and to Dr D. T. Jones and Mr Welldon of the Department of the Medical Officer of Health, the City of London, for provision and assistance with data from the City's own inventory. I would also like to thank my colleague, Dr S. W. Radcliffe, for many valuable discussions.

This article is published with the kind permission of the Scientific Adviser to the Greater London Council. Opinions expressed are those of the author and not necessarily those of the Council.

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'Framing Noise Legislation'

The Health and Safety Commission is suggesting that new legislation to limit exposure to occupational noise should cover everyone at work (At present the woodworking industry alone has statutory noise limits.)

The Commission has issued as a consultative document a report outlining a recommended framework for possible future legislation setting statutory limits on the noise exposure of workpeople in manufacturing industry generally. The report also recommends, however, that it should still be the basis for legislation if wider coverage of workpeople is decided on.

In circulating the document widely to interested bodies, including both sides of industry and local authority associations for their views on the form and content of legislation, the Commission has suggested that the regulations should be wider in coverage than the Factories Act and the Offices, Shops and Railway Premises Act, and extend to all persons covered by the Health and Safety at Work etc. Act. This would mean that coverage would extend to everyone at work, except domestic servants, including nearly eight million people who were not, before the coming into force of the Act, covered by any occupational safety and health legislation.

The report, "Framing Noise Legislation", was drawn up by the Industrial Health Advisory Sub-Committee on Noise. The sub-committee based its examination mainly on the present voluntary 'Code of Practice for Reducing the Exposure of Employed Persons to Noise' and came to the conclusion that the Code takes account of the modern practice and remains the best starting point for consideration of possible legislation. The sub-committee also took account of the recent Woodworking Machines Regulations 1974, which already impose statutory limits on noise in that industry, and made a survey of occupational noise controls in other advanced industrial countries.

Practical Noise Control

The Sound Research Laboratory are holding a series of two one-day courses conducted by professional acoustical consultants and scientists. The programme is designed to help engineers in the petrochemical industries in identifying practical solutions to the hazards arising from excessive noise and vibration. The dates are 15 April 1976 in Aberdeen and 4 May 1976 in London. Details on these and other courses can be obtained from: SRL, Holbrook Hall, Little Waldingfield, Sudbury, Suffolk.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Winter 1975)** *which gave the position up to* **30 September 1975.** *They now show changes and additions up to* **31 December 1975.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

As from 23 September 1974, the distinction between "black" and "white" areas has been discontinued. Because of this, the table showing the smoke control position in regions of England has been temporarily discontinued.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Northern

Darlington No. 11 (Pierremont) & No. 12 (Whinfield); Hartlepool Nos. 27-29; Langbaurgh (Teesside C.B. No. 20); Newcastle upon Tyne (Nos. 19, 20, 21, 21 (Newburn) & 22); South Tyneside (South Shields No. 21).

North Western

Bolton M.B. (No. 2 Farnworth No. 9A), (Horwich No. 7) & (Kearsley No. 7); Hyndburn (Nos. 34 & 35); City of Manchester (Woodlands Road & Anson Road); Oldham (Greenacres/Clarksfield); Preston (Nos. 30-33); St. Helens (No. 10); West Lancs D.C. (No. W.L.1).

Yorkshire and Humberside

Barnsley M.B. (Dearne No. 12); Calderdale (Halifax 20c) (Lee Bank/Pellon Lane); Harrogate No. 6 (New Park); Kingston-upon-Hull No. 14 (Newland West); City of Leeds No. 1 (Methley), No. 2 (Morley-Central), No. 120, No. 121 Holbeck (Brown Lane) & No. 122 Stanningley (Leeds & Bradford Road).

West Midlands

Dudley No. 132 (Kates Hill); East Staffordshire (No. 5); Newcastle-under-Lyme (No. 9A); Stoke-on-Trent (Nos. 29 & 30); Walsall (No. 21) Pelsall; Warwick D.C. (Nos. 1, 2 & 3).

East Midlands

Bassetlaw D.C. (Worksop Area No. 4) (Hemingfield/Prospect); Derby B.C. (No. 29); Gedling (Nos. 2 & 3); South Kesteven D.C. No. 1 (Grantham No. 23); Leicester (Nos. 36-38); City of Lincoln (No. 10); Mansfield D.C. (Nos. 1 & 8D); Newark D.C. (No. 4); Northampton (No. 12).

London Boroughs

Barking (No. 13); Bexley (No. 14); Bromley (No. 24); Harrow (No. 32); Kingston upon Thames (No. 24); Lambeth (No. 30); Newham (No. 13); Southwark (No. 31 Surrey Docks); Waltham Forest (Nos. 23-25).

South East

Gravesend No. 3; Gravesham No. 1; Guildford B.C. No. 3; Milton Keynes No. 1 (Bletchley No. 4); City of Oxford No. 16; Portsmouth No. 2; Southampton No. 16 (Portswood & St. Denys); Stevenage No. 6; Watford No. 12.

South West

Bristol No. 9.

East Anglia

City of Peterborough No. 3.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern

Allerdale No. 4 (Bolton Street/Workington); Darlington No. 13 (Albert Hill); Derwentside (Stanley No. 4); Gateshead No. 1 (Highfield, Rowlands Gill), No. 2 (Old Ford), No. 3 (Carr Hill) & No. 4 (Portobellow); Hartlepool No. 30; Newcastle upon Tyne No. 2 (Castle Ward), Nos. 8 & 9 (Gosforth), Nos. 22 & 23 (Newburn) & Nos. 23, 24 & 25.

North Western

Bolton No. 4 (Bolton Borough No. 50); Ellesmere Port No. 13; Liverpool No. 27; Warrington No. 2 (Thelwall).

Yorkshire and Humberside

Calderdale No. 11 (Todmorden/Portsmouth/Cornholme/Pudsey/Vale) & No. 21 (Halifax/Bradshaw/Warley/Wanstalls); Craven No. 1 (Glusburn-Part); Doncaster No. 2 (Conisbrough) & (Tickhill Nos. 3 & 4); City of Wakefield (Castleford No. 2) & Normanton No. 2).

West Midlands

Birmingham Nos. 159, 162, 530 & 531; Dudley No. 134 (Coombs Wood); Lichfield No. 1; Rugby No. 18; The Wrekin No. 1.

East Midlands

Amber Valley Nos. 1-3; Mansfield No. 3; Nottingham No. 7A; Nuneaton No. 14 (Bedworth Heath/Exhall West).

London Boroughs

Hillingdon Nos. 27 & 29; Merton No. 31; Waltham Forest No. 26.

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern

Allerdale No. 4 (Bolton Street/Workington); Darlington No. 14 (South); Middlesbrough Nos. 21-23.

North Western

Blackburn No. 16; Manchester (Cheetham); South Ribble No. 3; Rochdale (Oldham Road) & No. 3 (Archer Park/Middleton); West Lancs D.C. (W.L. No. 2).

SMOKE CONTROL AREAS

Progress Report

Position at 31st December 1975

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).

	England			*Wales*			*Scotland*			*Northern Ireland*		
Smoke Control Orders Confirmed prior to 30.9.75	4,564			21			247			64		
Acres		1,472,355			2,912			132,456			15,583	
Premises			6,573,393			10,499			566 173			41,952
Smoke Control Orders Confirmed (30.9.75-31.12.75)	47			—			2			2		
Acres		30,015			—			2,046			504	
Premises			88,208			—			4,479			1,301
Totals	**4,611**	**1,502,370**	**6,661,601**	**21**	**2,912**	**10,499**	**249**	**134,502**	**570,652**	**66**	**16,087**	**43,253**
Smoke Control Orders Submitted (30.9.75-31.12.75)	39			1			—			—		
Acres		28,652			369			—			—	
Premises			78,508			—			—			—
Grand Totals	**4,650**	**1,531,022**	**6,740,109**	**22**	**3,281**	**10,499**	**249**	**134,502**	**570,652**	**66**	**16,087**	**43,253**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

Yorkshire and Humberside

Doncaster No. 1; Kirklees (Mirfield Nos. 14 & 15) & (Huddersfield No. 18).

West Midlands

Birmingham Nos. 162 & 531; Coventry No. 18; Stoke-on-Trent No. 31; Walsall No. 24 (Pleck); Warwick No. 4; Wolverhampton No. 21 (Finchfield).

East Midlands

High Peak (Glossop No. 8); South Kesteven No. 2 (Grantham No. 24); Northampton Nos. 13 & 14.

London Boroughs

Bromley Nos. 25-27; Kingston upon Thames No. 25; Merton No. 31; Newham No. 14; Waltham Forest Nos. 27 & 28.

South East

Brighton No. 2; Dartford Nos. 14 & 15; Milton Keynes No. 2 (Bletchley No. 5); Watford No. 14 (Paddock) & No. 15 (Central).

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Belfast C.C. No. 11 (Var) & No. 12.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Castlereagh D.C. Nos. 2 & 3.

SCOTLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Clydebank (Dumbarton-Old Kirkpatrick) & No. 12 (Central); Dumbarton (Bowling / Milton); Dundee (Linlathan/Mid Craigie); Dunfermline (Pilmuir Street/Arthur Street/Townhill Road); Edinburgh (Colinton No. 4); Falkirk No. 12; Roxburgh (Hawick Central).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Dumfries (Castledykes); Dundee (Broughty East).

WALES

NEW SMOKE CONTROL ORDER SUBMITTED BUT NOT YET CONFIRMED

Delyn B.C.

ADDENDA

London Boroughs

Barking No. 16 (S.C.O. confirmed February 1975).

East Midlands

Chesterfield B.C. No. 9 (St. Thomas) (S.C.O. confirmed September 1975).

BOOK REVIEWS

Industrial Control Equipment for Gaseous Pollutants—Vols. I and II

By A. J. Buonicore and L. Theodore. CRC Press Inc. Vol. I \$39·95, Vol. II \$29·95.

This two volume publication examines the fundamentals and design principles of all types of equipment used in industry for the control of gaseous pollutants. The four basic concepts of control by absorbtion, adsorption, chemical reaction and dilution are reviewed from first principles and developed into typical operating equipment.

The introductory chapter in Volume I examines the overall strategy and need for control to eliminate atmospheric pollution and describes the present legislation requirements in the United States of America. Gaseous pollutants are identified and the various methods of detection and measurement are listed. While complete, it is considered that this section could have been usefully expanded to give some indication as to the accuracy of the determinations and the re-producibility of the analytical methods.

The authors have then usefully split the work into four sections, Parts 1 and 2, in Volume I, dealing with absorbtion and adsorption respectively and Parts 3 and 4 in Volume II covering chemical reaction and dilution as methods of control. Each part is similarly presented, in that each commences with a review of the fundamental approaches which are then developed into the actual design of equipment suitable for industrial control purposes. There then follows a description of the actual practical forms of equipment reviewing the properties and characteristics of each.

Part 1 dealing with absorbtion, examines the fundamental principles of diffusion processes, equilibrium states and mass transfer co-efficients as applied to absorbtion in liquid/liquid and gas/liquid applications. These principles are then applied to develop engineered designs of plant, mainly absorbtion towers having various forms of packings and plates, although various forms of liquid scrubber are briefly mentioned. The design procedure comprises an evaluation of solvent selection, equilibrium data, operational details, physical size of the absorber for optimum efficiency, the pressure loss and operating characteristics for a particular application. The authors have included many worked examples in this and other sections which should prove invaluable to both design and operating staff who are contemplating or already have this form of absorbtion equipment installed.

Adsorption, which has practical and economic advantages over wet scrubbing methods of gaseous control, is dealt with similarly to absorbtion in Part 2. The authors examine the two main types of adsorption which have been identified as either physical (van der Waal's) or chemical (activated) adsorption although both methods can exist at the same time. The four main adsorbents used in industry namely, activated alumina, activated charcoal, silica gel and molecular sieves are described together with their properties with regard to adsorption and regenerative characteristics. The process of adsorption involves three separate functions, the first ensuring contact between the fluid to be adsorbed and the adsorbent, secondly separation of the unadsorbed fluid from the bed and finally regeneration of the adsorbent or its replacement so that the process of adsorption can continue.

The effectiveness of a particular adsorbent in adsorbing a gas or vapour is determined by the physical conditions under which the material is exposed. The amount of substance adsorbed and the equilibrium pressure at constant pressure is determined by the adsorption isotherm; five general types of isotherm have been observed and examples of each are presented together with their equations of state. Typical worked examples are included demonstrating how these isothermal curves can be used in practice.

Chapter 5 is devoted to the design of practical adsorption devices commencing with the properties and selection of the adsorbent for a particular duty and the method by which adsorption will be achieved, that is, batch-wise, continuous or semi-continuous operation. Typical fixed, fluid and moving bed adsorbers are described, and various worked examples indicating how to evaluate the efficiency of the various devices, the effect of changes in inlet conditions and other operational characteristics for both vapour/solid and liquid/solid extractors are included in the text.

The opening chapter of Part 3 deals with the thermodynamic principles involved with chemical reaction, that is, the effect of temperature on enthalpy, phase and chemical equilibrium and various examples are given on how each is applied. This is followed by a chapter describing the principles of chemical kinetics, which is concerned with the study of the rates at which chemical reactions occur and the variables that effect these rates from an engineering viewpoint. The findings of the previous two chapters are combined and are applied to explain theoretically the functioning and operation of the three major forms of reactor. The batch type, usually used for experimental studies, is dealt with in detail and covers the two industrial types, namely tank flow, where the two reactants, normally liquids, are held in intimate contact by agitation and stirring; and tubular flow where the reactants mix within the tubes by control of flow, which can be in a plug, laminar or turbulent state or any combination of all three. In any of the equipment, reaction speed is controlled by operational conditions such as temperature and pressure and, again, worked mathematical examples are included in the text.

The concluding section of Part 3 is devoted to thermal and catalytic combustors and flares, these devices being used to control the emission of fumes, vapours and odours to atmosphere, in essence they can be considered as being tubular flow reactors. Flares are used where concentrations of pollutant are high and operate at temperatures between 1100 and 1500°C, thermal reactors operate at between 600 and 800°C and catalytic reactors between 300 and 500°C. Care must be exercised with these combustion devices to avoid explosion risks. With thermal combustors or "afterburners" a factor of 4 is taken as the "norm" for safety reasons; to provide the necessary temperature for reaction to be efficient, auxiliary fuel is normally burnt in this type of reactor. Practical designs of both the thermal reactor and catalyst combustor are considered by the authors.

The final part of this work is devoted to control by dilution techniques, which is of the utmost importance to the engineer who is faced with a difficult odour control problem. The section commences with the introduction of equations for momentum and energy transfer and the mechanism of mass transfer as applied to molecular diffusion, these equations are then developed into Fick's Law of Mass Transfer. La-place transformations are presented in order to provide solutions to instantaneous and continuous sources of pollution leading to atmospheric diffusion coefficients and the prediction of ground level concentrations by means of various models.

These ground level concentrations are of the utmost importance in this form of control, which in some instances is the only practical method, since with this technique, pollutants are not removed but only diluted. To provide an acceptable ground level concentration it is imperative that the chimney or stack is of the correct height and the authors review all the necessary factors such as meteorological characteristics, topography lapse rate and plant factors to enable the effective plume height and dispersion characteristics to be calculated. Examples of various methods of estimating ground level concentrations and stack heights by means of Sutton's Equation and the Bosanquet Pearson Method are presented as well as the details that must be considered in the design of single and multiple stacks.

To summarise, the authors have carried out an exhaustive treatise on the subject of gaseous pollution control and the two volume work should provide an excellent source of information for the engineer faced with a control problem. The work, while being extremely theoretical and technical in parts, is presented with the engineer in mind and typical examples on how the theory is applied and methods of calculation as well as practical forms of control equipment are included. Each chapter is systematically divided and there is an abundance of references to other works and papers which should enable the reader to delve further into any particular section. The use of the publications, as an introductory reference work, is somewhat inhibited since the only cross reference between the volumes is contained in the common preface, otherwise they form an excellent review of the subject being individually well indexed and referenced.

K. R. Parker

111th Annual Report on Alkali etc. Works 1974

Department of the Environment, Scottish Development Department, Welsh Office. HMSO. £2·25 net.

"This is an historic Report, because it is the last to be presented under the Alkali Acts . . . It marks the end of a long tradition, the beginning of a new era."

It is sad to think that this may well be the last Report in the form which we have come to accept and look forward to each year. But, as Mr. Ireland says, "it is hoped that there will be an opportunity afforded in the new (Health and Safety at Work) Executive to continue to write published reports about the work of the Alkali and Clean Air Inspectorate in its new guise."

The number of works registered under the Act at the end of 1974 was 2,147 involving the operation of 3,159 processes. The total number of visits and inspections during 1974 was 13,647 compared with 13,680 in 1973. Of these, 237 were to, or in connection with, works not registrable under the Act and 52 were concerned with radioactive emissions. Members of the testing teams made 719 visits to works, where they carried out 383 tests for grit and dust, 827 tests for fumes and 368 of a chemical nature. The number of complaints in 1974 was 471 and of the 471 works investigated, 402 were works registered under the Alkali Act and 69 were non-registrable. Some were serious complaints and others related to minor matters. Complaints against registered works were most numerous against mineral works (114), electricity works (44) and iron and steel works (31). Complaints investigated against non-registered works, at the request of local authorities, were most numerous against general chemicals and foundries. There was a considerable increase in registered and non-registrable works under complaint compared with 1973.

The Report might be said to take the form of a review of how the responsibilities of the Alkali Inspectorate have grown and what has been achieved in a period of 111 years. Mr. Ireland's reports always make extremely interesting reading; they are always highly informative. This Report is as readable as ever and, if anything, contains even more information than previous Reports.

Mr. Ireland concludes his report "These Annual Reports are valued as a history and serial story of the work of the Alkali Inspectorate and of air pollution control generally. It would be a pity if they were to end now. If we need a memorial to the Alkali Act, let us look at the cleaner air around us."

Dr. Birse's report to the Secretary of State for Scotland also makes very interesting reading, and it is significant that during the year, 853 visits were made in connection with the Alkali Act and a further 111 on similar works were made concerned with air pollution. Dr. Birse adds "Inspection of mineral works and following up North Sea oil developments spread the territorial coverage into areas not usually associated with industry. The Hebrides, Orkney and Shetland may not yet require frequent visiting but the need is growing."

Complaints in Scotland were generally at a similar volume to that of previous years. Dr. Birse says that "the causes to most complaints are transitory and the circumstances about them have to be established as soon as possible for the factual reliability which is essential in pursuing remedial action. In this work we have much co-operation from Environmental Health Officers in local government who, as fellow professionals, appreciate the need for accurate observation."

Advances in Environmental Science and Technology—Vol. 5

Edited by James N. Pitts, Jr. and Robert L. Metcalf. Associate Editor Alan C. Lloyd. Wiley-Interscience 1975. pp. 371. £14·20.

Mechanisation and mass production of pots, pans and motors has plunged country after country into industrial air and water pollution. Hence comes the present worldwide demand for advances in environmental science and technology. This is the fifth volume of the series of hardbacked books, the first of which was reviewed in the Society's "Smokeless Air", summer 1970, pp.311-314. Now the same experienced American editors have obtained well qualified writers to expound their fields of air pollution control work in Japan and Australia where scientific knowledge of fuels and disciplined control of their use has become essential.

Before studying these instructive first two sections of this book it is well to note that in the UK we have 55 million people on 93,000 sq. miles, in Japan 104 million people on 143,000 sq. miles, and in Australia 13½ million people on about 3 million sq. miles.

The book's first 90 pages report a study that was supported partly by the Japanese Society of Mechanical Engineering and by the fund provided by the Education Ministry, Japan, for the special research programme of environmental control. The contract was offered by the Japan Automobile Association. Jiro Kondo and Majime Akimoto, the authors, entitle it "Air Pollution in Tokyo: An Application of Computer Simulation".

Early in the 1880s and 1890s fumes from copper works elsewhere in Japan had hazarded local residents, damaged crops, fishing and human health. In 1885 fallout from a cement plant became a social problem in Tokyo. The 1939-45 wartime priority of production caused air pollution from which many residents suffered respiratory disease. After 1955 Japan's economy advanced with exponential growth of energy consumption and the switching of the main energy source from coal to oil.

By the latter half of the 1960s visibility had become the worst in Tokyo's history. The famous view of Mount Fuji, which before 1880 was seen about 100 days a year, was only visible on 39 days in 1967 and Tokyo's citizens lived in fear of illness from air pollution.

The first air pollution control law in Japan came in 1962 "The Smoke and Soot Regulation Law" but the situation was worsening and SO_2 concentrations in ambient air peaked during 1966-68. There was in the latter 1960s a surprising outburst of urbanisation and motorisation in Japan such as has never been seen in history. Their motor vehicles totalled about four million in 1965 and 18 million five years later. Japan's urban population increased from 38% in 1950 to 72% in 1970, noticeably deteriorating living conditions in large cities.

In 1970 about 85% of Japan's total crude oil imports came from the Middle East countries. But the Middle East crude oil, on which Japan had become overwhelmingly dependent, contains the high average sulphur content of 2·5%. Hence SO_2 and sulphuric acid mist had become Tokyo's predominant air pollution, and indeed in half a dozen big Japanese cities.

In 1970 photochemical smog was first clearly noted in Tokyo and has spread throughout the major cities of Japan. The authors tabulate the Primary Pollutants thus:

> SO_x: From industry, offices and power plants. Oxides of sulphur and suspended particulates have long been the main nuisances for the citizens of Tokyo.
>
> CO: Automobile exhaust has produced a great amount of carbon monoxide which increased from 1964-69 but regulation of CO went into effect in 1968 since when though decreased it has remained unacceptably high.
>
> NO & NO_2: The most characteristic change of the air of Tokyo in the past few years has been the marked increase in concentrations of NO and NO_2.
>
> Hydrocarbons: It is important to know the composition of the hydrocarbons to assess the emission sources as their effectiveness as catalysts of photo-oxidation of the above nitrogen oxides varies greatly.

These authors have here included many diagrams of the Tokyo area concentrations of SO_2, NO, NO_2, HC and O_3 especially interesting now that IUAPPA is organising the 4th International Clean Air Congress to be held there, May 1977, following those in London 1966, Washington 1970, and Düsseldorf 1973.

The Status of Air Pollution and its Control in Australia is the heading of the second section of this book, some 128 pages, in which the authors, David Iverash and R. W. Bilger, have produced a readily understandable survey. Mainly they deal with basic considerations, industrial pollution, motor vehicle pollution, making a special case study of photochemical pollution in Sydney.

The pastoral Australia of a century ago, exporting wool, wheat and meat, has changed to a nation in which three-quarters of the people live in towns: Sydney and Melbourne three millions each, and Adelaide, Brisbane and Perth approaching one million each.

Even when those towns were much smaller before 1900 air pollution was a serious nuisance. In 1908 a Smoke Abatement Act was passed in New South Wales but effective legislation did not come until Australian public interest had been influenced by accounts of the fatal smog episode in Britain during 1952.

By 1967 all the Australian mainland States had legislation that closely followed British practice and in 1968 the Australian Federal Government set up a permanent Senate Select Committee "to enquire into and report upon air pollution in Australia".

The key to successful control of Australian air pollution lies, according to these authors, in development of a national energy policy, and especially in quick development of their natural gas resources as a fuel for industry.

Their really informative survey is concluded with a seven-page long list of 108 references.

The Combustion Aspects of Air Pollution is the theme of the third section of this book. The majority of man-made air pollution emissions comes from combustion sources. Combustion powers road vehicles, aeroplanes, diesel locomotives, most electricity generating plants, heats homes and provides hot water.

It is appropriate therefore that the author G. Scott Samuelsen has devoted much care to the fundamentals of combustion, its chemistry and fluid mechanics in the 109 pages of his part. He has considered separately automobile engines, diesel engines, gas turbine engines, electric generating steam power plants and packaged boilers.

In the USA packaged boilers are responsible for 26% of the NO_x emissions from stationary sources and are so named because they are shop erected (versus field erected) and transported as a package by rail.

For those who wish to pursue the subtleties of combustion-generated air pollution he concludes with a helpful "Nomenclature" list of meanings of the mathematical terms used, and also gives 84 references.

The fourth and smallest section of this book, "Cybernetic Modelling for Thermal Pollution Decision Making", has been written in technical jargon that will be incomprehensible to all but a relatively few specialists. Its first study of the cybernetic philosophy of ecosystem modelling leads after 40 pages to the devastating statement that the model does not explicitly consider the synergistic effects between heat and chemical or organic pollutants.

It is worth remembering that the Greek origin of the word 'cybernetic' meant steersman. It is to be hoped that the author will someday manage to steer us, in short words of English origin, away from the Nephelococcygia of Aristophanes, known in English as Cloud-Cuckoo-Land, to control of air pollution.

T. Henry Turner

The Recycling and Disposal of Solid Waste

Proceedings of a Course held at the University of Nottingham, 1st-5th April, 1974. Edited by M. E. Henstock, University of Nottingham. Pergamon Press Ltd. 226 pages. £6·30.

As the foreword to this book says, "there is, today, a greater awareness than ever before of the critical dependence of western civilization on a continued supply of raw material . . . In such a situation the United Kingdom is particularly vulnerable, and increasing efforts are being made to utilise to the full the materials whose purchase can be made only at the expense of our overseas trade balance. Rejected materials formerly described as 'waste' are increasingly being looked upon as rich ores whose characteristic is diversity as opposed to the relative consistency of most conventional ores."

This book, which consists of 16 papers presented to a course at the University of Nottingham, not only makes particularly interesting reading but at the same time is a complete textbook in its own right. The scene is set by the first paper by Mr. M. E. Henstock on 'The Economic Potential of Recycling'. Other papers deal with incineration, pyrolysis and hydrolysis; organic wastes; glass recycling; ferrous metals recycling; textiles recycling; polymers recycling; and non-ferrous metals recycling. Legal aspects are also dealt with as are the air pollution problems connected with solid waste disposal; and although the purpose of the book is to preach the gospel of the avoidance of waste and the recycling and reclamation of valuable materials, the problems associated with the sorting of solid waste and tipping and sanitary landfill are not neglected.

Although essentially, a textbook and a book of reference, this volume has been carefully put together and makes interesting and easy reading for all who are interested in the environment. For those who are concerned with wastes and their reclamation and disposal, it is essential reading.

New additions to the NSCA Library

Advances in Environmental Science and Technology—Vol. 5. Ed. James N. Pitts Jr. and Robert L. Metcalf. Wiley-Interscience. 1975. 371 pages. £14·20.

Air Pollution Control: an integrated approach. Royal Commission on Environmental Pollution 5th Report. January 1976. HMSO. £1·75.

Air Pollution in Edinburgh. Part I—The Background to Research. A. J. Crosbie, Nicola Crosbie, J. H. A. Dick. Report on Ministry of Technology, Warren Spring Laboratory. Department of Geography. University of Edinburgh.

111th Annual Report on Alkali etc. Works 1974. Department of the Environment, Scottish Development Department, Welsh Office. HMSO. £2·25 net.

Asbestos: Health Precautions in Industry. Health and Safety at Work Series. Health and Safety Executive. 1975. HMSO. 20p.

HM Chief Inspector of Factories Annual Report 1974. Department of Employment. HMSO. 1975. £2·05.

The Identification and Measurement of Refinery Odours. Stichting Concawe Report No. 8/75. The Hague. December 1975.

National Survey of Air Pollution, 1961-71. Vol. 2, South West, Wales, North West. Warren Spring Laboratory. 1972. £3·50.

Noise—Fighting the most widespread industrial disease. Tony Fletcher. The British Council for Social Responsibility in Science. August 1975. 25p.

Published Regulatory Guidelines of Environmental Concern to the Oil Industry in Western Europe. Stichting Concawe Report No. 1/76. Replaces Report No. 6/75. Stichting Concawe, The Hague. January 1976.

The Recycling and Disposal of Solid Waste. Michael E. Henstock, Editor. Proceedings of a course held at the University of Nottingham, 1-5 April 1974. Pergamon Press. 1975. 226 pages. £6·30.

Report of the Coastal Pollution Research Committee of the Water Pollution Research Laboratory. Department of Environment. 1975. HMSO. 65p.

Smoking and its Effect on Health. Report of a WHO Expert Committee. Technical Report Series 568. WHO Geneva. 1975. £1·35 (from HMSO).

The Sulphur Grid Method. A Tool for Assessing the Requirements of Low Sulphur Crude and/or Residue Desulphurisation Capacity to meet Varying Fuel Oil Sulphur Levels. Stichting Concawe Report No. 9/75. Stichting Concawe, The Hague. December 1975.

A Survey of Atmospheric Trace Elements in the UK: Results for 1974. P. A. Cawse. Environmental and Medical Services Division, AERE Harwell. May 1975. HMSO. £1.

A Survey of Respiratory Disease in the Pottery Industry. Health and Safety Executive. 1975. HMSO. 35p.

Technology and the Environment—Toxic Substances in the Environment. Reports from Scientific Counsellors Overseas No. 9. 1975. Department of Industry.

Air Pollution Discussion Meeting

On Saturday, 24 April 1976, a one-day discussion meeting on 'Air Pollution' will take place at the University of Manchester, Institute of Science & Technology (UMIST). The Royal Meteorological Society has planned this meeting with the amateur meteorologist particularly in mind, though those with a professional interest in atmospheric pollution can also expect to benefit from participation in the meeting, which is open to non-Fellows.

Time has been allowed for discussion after each paper and for a general discussion at the end of the meeting.

The papers to be presented are:

The Role of Meteorology in the Study of Air Pollution (Dr. A. W. C. Keddie, Warren Spring Laboratory).

The Meteorological Problem of Urban Pollution and Simple Schemes for Estimating Pollution Concentrations (Dr. F. B. Smith, Meteorological Office).

Smoke and Sulphur Dioxide Pollution in Non-Source Areas (Dr. R. A. Barnes, Department of the Environment).

An Examination of the Dispersion of Air Pollution using ERTS (LANDSAT) Imagery (Dr. T. Davies and Dr. P. Brimblecombe, Department of Environmental Sciences, University of East Anglia).

Dispersion of SO_2 from Tall Stacks (Dr. B. E. A. Fisher, Central Electricity Research Laboratories).

Photochemical Air Pollution (Dr. S. Penkett, UK Atomic Energy Research Establishment).

Air Pollution by Heavy Metals (Miss J. Ratcliffe, Department of Mathematics, Imperial College of Science & Technology).

Enquiries should be made to: The Executive Secretary, Royal Meteorological Society, James Glaisher House, Grenville Place, Bracknell, Berkshire RG12 1BX.

The case against unrestricted access to National Survey data

by

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At one time I thought that all National Survey data should be provided to anyone who asked for it, whatever his or her interest. However, as a result of my experience with data from another long-lived and widespread monitoring network—the European Air Chemistry Network (EACN)—I am now convinced that we cannot afford such a policy of indiscriminate distribution of air pollution data. There are so few people available to interpret the National Survey data that their individual efforts will be squandered if each study does not enhance the others by illuminating the same and surrounding ground. It might be possible, by selecting the best few dozen sites from the thousand or more in existence, to compile a file of manageable size and confirmed quality with which future research may be undertaken with far greater confidence than is now possible.

While the EACN and the UK National Survey of Smoke and Sulphur Dioxide differ in some conspicuous ways, their similarities are notable. The EACN samples rain and snow on a monthly basis, analysing for 10 ions in solution, while the National Survey collects daily samples of smoke and sulphur dioxide in the air. The EACN publishes all data in detail while the National Survey reports only the summary results. But both networks are operated as a number of contiguous sub-sections, each with its own laboratory, reporting their results to a central administrative office. The sub-sections do not overlap and do not in general communicate with each other. The oldest stations have run for more than 20 years and many other stations have been run for shorter periods. In that time the personnel have changed. Attached to the central office there is a research team which is capable of analysing only a small fraction of the incoming data. The value of the data is seen to reside in part in its applicability to research by other institutions. The standard form of analysis leaves unanswered many questions of fundamental interest to the authorities in the sub-sections of the network.

While some local authorities have full-time air pollution sections, most must put their National Survey work in the hands of people whose training and principal concerns are in other areas of public health. My experience of the EACN suggests that there can arise subtle influences which will distort the monitoring results and deceive us when we try to understand the ways of the atmosphere. Some of these influences, such as the smoke monitoring problems in Sydney which were reported to the Standing Conference of Co-operating Bodies in November 1973(1), simply conceal the orderly behaviour of the atmosphere which we should know about if we are to do the best job of pollution control. In other cases(2) the distortions have given rise to quite fallacious theories about the chemistry of atmospheric aerosol. At the local authority level it would take a very gifted person with a great deal of free time to identify the principal errors which may arise in the file of National Survey monitoring data. Where the data from several adjacent sub-sections are available it may be possible to verify sub-sets of the data, inform the operators where malfunctions have occurred in their system and reach some useful conclusions about air pollution and the atmosphere in Britain from analysis of the valid data.

At risk of stating the obvious, I should like to point out that there is no ' ultimate ' analysis of a body of environmental data. Each different analysis brings in other variables which may have been related to that state of the atmosphere which brought so much smoke and sulphur dioxide to the monitoring instrument on that day. In the course of the years a body of air pollution data may be analysed in conjunction with agricultural, health, meteorological or other pollution data. Each successive analysis which incorporates a body of data enhances the subsequent value of the data so long as the results of the analysis are published, or at least made available to future investigations. Where the data is found to be wrong a warning may be issued against its use in later work.

It is timely to consider how often the data collected by your local authority has been used. The chances are that those numbers, collected at a cost of about 50p each, have never been used except in the bare National Survey summary. One half of the local authorities in the United Kingdom may have received written requests for permission to use their detailed data but in only a minority of these cases will they have seen the results of such analyses. In some areas the students from local Polytechnics or Universities may have worked on the data and in other cases they will have been deterred by the requirement of applying both to the Warren Spring Laboratory and to the local authority for permission to use the data. However, such exercises are generally of greater value to the student than to the local authority. The analyses done so far have been so scattered that they have hardly contributed to our knowledge of the strengths and weaknesses of the various bodies of National Survey data. Indeed a number of studies have been terminated prematurely upon the realisation that the particular body of data used was defective in some way.

I believe that it is time now to recognise that most of the National Survey data will never be used in any significant research. Since in all probability only a fraction of the data is suitable for use in scientific research, either of an applied or an academic nature, we should try to identify that data and proffer it to the intending researcher. Such a move should lead to the maximum amount of effective research and the most positive results because the data with both a pedigree and proven performance will attract the attention of more serious research. Successful completion of one project encourages subsequent work in the same field.

The following factors should qualify a body of data for inclusion in a premium file:

1. a long period of record
2. continuity of staff with enthusiasm for the monitoring
3. additional air pollution data, possibly on dust deposition, lead peroxide candle sulphation and hourly smoke monitoring as well as the standard 24-hour smoke and sulphur dioxide measurements
4. monitoring on every day of the week
5. supporting weather data from a nearby Meteorological Office station
6. supporting agricultural or medical data from neighbouring areas
7. duplication of instruments at one or more sites
8. detailed studies in the region by the Electricity Generating Board, Medical Research Council, etc.
9. an adjacent authority with similar data of good quality to allow studies to cover a greater geographical area with some internal checks.

Further consideration of the problem will yield other factors which are pertinent. It is unlikely that any site or group of sites will satisfy all these criteria. However, if an initial selection is made on the best available information our subsequent experience will tell which of the stations have been especially reliable. With time, some of the stations will be dropped as deficiencies are revealed while others will be added when experience shows that they are of high quality. For the newcomer to air pollution research those stations which have been most tested in various analyses will be the most attractive for initial studies. It is possible that with time and experience it will become obvious just how the results from a new station, or group of stations in a region, should be analysed to verify their quality.

It seems reasonable that access to data not included in the premium file should continue to be allowed on the present basis. The premium file itself should be available to anyone. As the daily records for 10 years or more from a few dozen stations, the full extent of the premium file which I propose, amounts to several hundred thousand pieces of data it would perhaps be sensible to make it available on magnetic tape. A printed summary file, of only a fraction of the information, might be produced for sale at a modest price for use in schools, Polytechnics and by the amateur whose interest is at the level of those who keep a wet and dry bulb thermometer in their garden. If the format on tape and in loose-leaf printed form is properly selected it should be a simple matter to bring either form of the file up to date each year or so.

The Warren Spring Laboratory and the local authorities must decide between them which stations merit inclusion in the premium file. The data would become public information but the local authority would stand to gain by the inclusion of its data for it would quickly learn from the successive analyses the lessons which may be drawn from its monitoring. These authorities would certainly enjoy a greater return on their investment in monitoring than has hitherto been obtained by participants in the National Survey. Researchers and teachers would benefit by having available for their studies an immediately accessible file of the best air pollution data in the country.

By publishing this data are we not letting the cat out of the bag? Some people are seriously concerned that the data would be used for mischievous purposes and cite cases where air pollution data has been quite clearly misused to the discomfort of local government or industry. But is the cat not already out of the bag? Monthly averages and highest daily concentrations in each month are published already by the National Survey. Will the second highest daily concentration, or the date of its occurrence, embarrass anyone? And if the CBI, a Trade Union or a local action group were to ask through the normal channels for the daily data, is there any chance of their request being refused because they might misinterpret the data?

We are in greater danger of being told that there is no useful information in the data. The only way to counter such claims is to have the data verified by its repeated use. And the more use it has found among disinterested people the more authority it carries when used by those who have a legitimate case to make. This has been one of the critical shortcomings of the European Air Chemistry Network. Up to the time when the EACN data was used in the Swedish submission to the UN Conference on the Human Environment in 1972 there had been a negligible amount of outside analysis. Since 1972 the outside analysis has simply shown that much of the data and some of the interpretation of the data has been seriously in error. The EACN data was first published in a systematic form in 1968 and it is only now becoming clear which parts of it are reliable. By comparison the vast files of the National Survey of Smoke and Sulphur Dioxide are an uncharted wilderness with gardens to be found among the expanses of jungle. It is our choice whether we turn people loose in the jungle or guide them to the garden. If the harvest of the gardens is to be brought in, we cannot afford to lose too many in the jungle.

References

(1) Scorer, R. S. (1973). Problems connected with surveys of chemical components in the atmosphere. Standing Conference of Co-operating Bodies, 12/11/73.

(2) Paterson, M. P., and Scorer, R. S. (1975). The chemistry of sea salt aerosol and its measurement. Nature 254, Pp 491-95.

POLLUTION ABSTRACTS

22 Air pollution from energy production and use. John A. Haines. Clean Air (Australia/New Zealand), Vol. 9, No. 3, August 1973.

The paper describes some of the work being done through the OECD to examine the implications for air pollution of changing sources of energy supply, and discusses some of the international issues involved. The problems of the increased total emissions of sulphur oxides and particulate matter arising from fuel combustion in stationary sources are examined in detail; national and international issues involved including trans-frontier pollution are considered. The problems of nitrogen oxides, hydrocarbons, photochemical oxidants and thermal discharge from energy use, which are also under consideration in the OECD Programme, are referred to in less detail.

Reader Enquiry Service No. **764**

23 Asbestos: rationale behind a proposed air quality standard. L. Bruckman and R. A. Rubino. Journal of APCA, Vol. 25, No. 12, December 1975.

Following the examination of standard setting in Europe that was presented at the Brighton Clean Air Conference in October, an interesting comparison is presented in this paper of the USA method in proposing an asbestos air quality standard and the rationale utilised in its formation. The criterion of mesothelioma has been selected as the basis for developing the subject standard. Mesothelioma, asbestos-induced cancer of the lining of the stomach and lung, has been found to develop in workers after (relatively heavy) exposure over a long period to asbestos fibre dust. It has been reported that the period between first exposure to asbestos fibres and the first symptoms of this form of cancer may be anywhere from 20 to 40 years. This fact has led to studies linking the incidence of mesothelioma among the general population to asbestos fibre exposure which took place over 20, 30 or more years ago. Both occupational and non-occupational exposure to asbestos, and the consequent health effects, are examined to decide a desired ambient air asbestos level, which was calculated on the smallest possible probability of contracting cancer, against a concentration-mesothelioma incidence curve. Dispersion calculations are used to determine the maximum allowable asbestos mass emission standard for manufacturing sources, and a maximum allowable average asbestos concentration. A preliminary asbestos stack sampling train has been developed requiring electron microscopy as the analytical procedure to be used to determine the sample asbestos content. The standard is projected to result in 150 (U.S.) nation-wide fatalities.

Reader Enquiry Service No. **765**

24 Reduction of gaseous emissions. R. Katshuri and K. Reither. The Chemical Engineer, No. 304, December 1975.

This article discusses the technical processes which produce waste fumes and examines a purification method based on absorption, for waste gas which may contain dusts or noxious vapours in gaseous form, the latter often being the reason for unpleasant odours being spread. The installation discussed was designed as a spray wash tower combined with an effective means of mass transfer using a specially vacuum formed packing. It is built in two types, for horizontal and vertical gas flow. The design features of the scrubber are given in detail, with an explanation of its flexibility, enabling it to handle contaminant gas flows containing different types of noxious material at varying concentrations, with different scrubbing liquids and a choice of gas velocity. For individual applications, appropriate tests have to be carried out to establish the basis for these design calculations. Examples are given of different processes in which the application of the installation would be appropriate, among which are synthetics manufacture, chlorine/alkali electrolysis, pickling, the galvanising industry, tempering workshops and mineral water production. Especial reference is made to odours removal, for which the authors advocate the absorption of odourous fumes in a gas washing installation, and their subsequent oxidation by ozone in an aqueous solution.

Reader Enquiry Service No. **766**

25 Reducing atmospheric pollution from oil-fired plant: development of grit-arresting cyclones for multi-flue chimneys. B. Lees and R. W. Butcher. Journal of the Institute of Fuel, December 1975.

This short, but thorough, practical paper is a working proposition to show that smut and chimney corrosion in oil-fired plant can be avoided if chimneys are designed to ensure that their inner surfaces are maintained at temperatures above the acid dew-point under normal operating conditions including fluctuations in load. One method of achieving this being to adapt multi-flue chimneys, the authors describe a grit arrestor designed to fit beneath each of the flues, utilising the space in the base of the multi-flue chimney. The theoretical principles behind the design of the cyclone are given: it is shown that a high proportion by weight of the unburned solids in flue gases from oil-fired plant is in the range of 5-50 micrometers. Bench trials showed that a high proportion could be collected by grit-arrestors of conventional design. It is also shown that the conventional (Ter Linden) cyclone arrestor can, without increase of external diameter, be modified to operate with low pressure-drop and yet maintain adequate efficiency. With a pressure-drop lower than 50mm wg the unit is suitable for fitting on many package oil-fired boilers and water-tube boilers without extra fans. The efficiency of the grit arrestor is adequate to enable the plant to operate at levels of grit- and dust-emission well below those allowed by the Clean Air Acts in the U.K. and similar regulations in other countries.

Reader Enquiry Service No. **767**

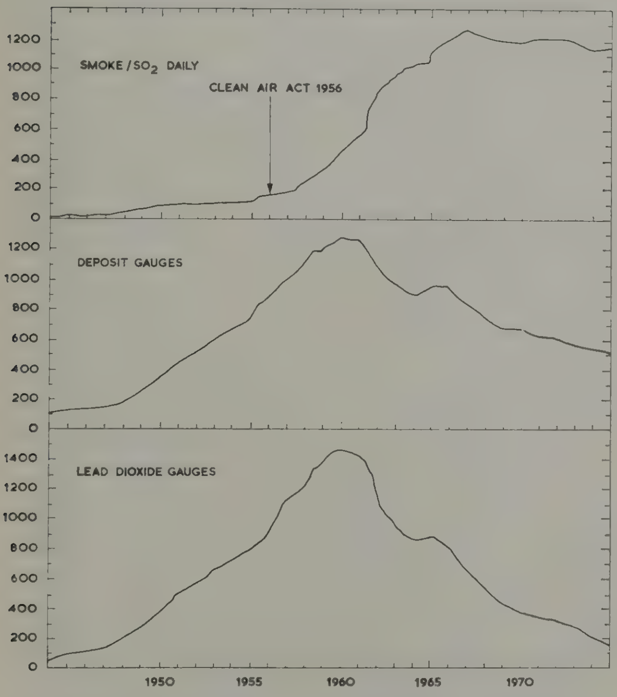
26 Global atmospheric consequences of the combustion of fossil fuels. T. K. Deague. Journal of the Institute of Fuel, September 1975.

In this report, an assessment is made of the possible global atmospheric consequences of the continuous combustion of fossil fuels on a scale which is large enough to provide a substantial part of the world's energy requirements. Carbon dioxide and particulate matter are identified as the two chief agencies through which fossil fuel combustion is most likely to exert a harmful effect on the atmosphere of the entire globe. The relevant observed data, correlations, causal relationships and mathematical models pertaining to CO_2 and particulates are examined in detail, and their implications for the global atmosphere are discussed. The conclusion reached is that at present, there is no firm scientific evidence either for or against the proposition that fossil fuel consumption will cause a catastrophic change in global temperature over the next few decades. The basis for this conclusion is a careful examination of mathematical modelling practices as applied to produce a causal chain resulting in a 'greenhouse effect' prediction. The authors feel that their report has important implications for the formulation of energy policies. They submit that fossil fuel combustion, with no proven concomitant global problems, could well be the most attractive alternative for the large scale production of energy over the next few decades.

Reader Enquiry Service No. **768**

The National Survey

Number of Instruments in Operation in the United Kingdom 1944-1975



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World Gas Conference

The thirteenth World Gas Conference of the International Gas Union will be held in London from 7-11 June 1976. The opening ceremony will take place in the Royal Festival Hall, and subsequent sessions in Queen Elizabeth Hall, the Purcell Room and the National Film Theatre. During the Conference, a special international gas exhibition will also be staged in the South Bank complex.

Thirty-five countries are now in membership of the International Gas Union, representing over 95 per cent of the world's gas industries. It is expected that more than 2,000 delegates will be attending the Conference, which is held every three years.

Papers to be presented to the Conference—more than eighty in all—will cover all aspects of the international gas industry—production, treatment and storage of natural gas; gas manufacture, transmission and distribution; the utilisation of gas (domestic, commercial and industrial), gas marketing, and a variety of other topics. There will be a continuous programme of gas industry films in the National Film Theatre.

Hevac '76

The International Heating, Ventilating and Air Conditioning Exhibition, to be held at the National Exhibition Centre, Birmingham, from 5-9 April 1976, incorporates a new section aimed at promoting interest in the harnessing of solar power.

Outdoor sites are being provided where exhibitors can display and demonstrate solar energy equipment and systems.

New Chairman for Solid Smokeless Fuels Federation

Sir Frederick Scopes retired as Chairman of the Solid Smokeless Fuels Federation at the end of December.

He was first appointed Chairman in 1954—the year he received his knighthood—and was Independent Chairman from 1963.

Born in 1892, Sir Frederick was educated at King Edwards Schools, Camp Hill and New Street, Birmingham where he attained an MA as a Modern History Scholar. He served as Managing Director, and later Chairman, of the Stanton Ironworks Co Ltd from 1942 to 1962.

He is succeeded by Mr Francis L. Waring, CBE, a director of Coalite & Chemical Products Ltd.

Mr Waring joined Coalite in 1915 as a junior and general assistant. He was elected a director in 1946 and later became Chairman in 1971. He relinquished the Chair in 1975, after 60 years of service, but continues as a director. He has served on committees of numerous associations allied to the fuel industry.

A vital exhibition in a new setting

The third Environmental Pollution Control (ENPOCON) Exhibition will be held in the new National Exhibition Centre, Birmingham. It will cover all equipment, plant, products, services, systems and supplies associated with the fight against pollution—including pollution of land, air, sea and waterways. Main categories will be solid-waste pollution, air pollution, noise and vibration pollution, radiation pollution and sea and water-ways pollution.

Overseas Visitors

The last ENPOCON exhibition in 1973 attracted visitors from nearly every country in the world. The 1976 event will run concurrently with the Effluent and Water Treatment and with the Public Works Exhibition, each Exhibition having its own area in the NEC. This means that an audience of tens of thousands will have the opportunity to visit ENPOCON exhibitors *(at the last Public Works Exhibition there was an attendance of over 90,000 influential visitors from 62 countries).*

Write for full details now to
the Exhibition Manager: Howard Phillips

Exhibition Organisers:
Brintex Exhibitions Limited
178-202 Great Portland Street
LONDON W1N 6NH
Telephone: 01-637 2400

The next

Environmental Pollution Control Exhibition

will be held at
The National Exhibition Centre
Birmingham England
15-20 November 1976

enpocon

Reader Enquiry Service No. **769**

National Society For Clean Air

NEWS FROM THE DIVISIONS

LONDON & SOUTH EAST & CENTRAL SOUTHERN

Visit to Imperial College of Science and Technology

A party consisting of fifteen members and representatives took part in a visit to the Department of Civil Engineering at the Imperial College on 10th December 1975. The proceedings commenced with a talk by Dr. R. Perry on methods of air pollution measurement, the problems relating to pollution by motor vehicle engines and the various methods of reducing such pollution. This talk proved to be very interesting and was illustrated by a large number of slides. Many members participated in the subsequent discussion and a vote of thanks to Dr. Perry was made by the Chairman, Mr. T. H. Iddison, during the tea which followed.

The party then proceeded on a detailed tour of the laboratories. Particular interest was shown in the mobile laboratory which is used for measuring air pollution and contains a considerable quantity of equipment.

Although the number forming the party was small, those who attended this visit found that it was well worth the effort.

B. C. Upton
Hon. Secretary

NORTHERN

On Friday, 13th February 1976, a combined meeting of the Joint Clean Air Committee for the North East, and the Northern Division of the National Society for Clean Air, was held in the Ramside Hall Hotel, Durham. A total of 78 members attended this meeting, the principal function of which was to give Northern local authorities an opportunity to see a presentation of photographic material entitled "Save It" and "The Sixty Year Investment" by the Solid Smokeless Fuels Federation.

At 11 a.m. members assembled for coffee and following a brief screen show entitled "Beauty", delegates were welcomed by Mr. H. Procter, managing director of Randolf Coke and Chemical Co. Ltd., who chaired the meeting. The theme of this meeting was smoke control progress, during the course of which emphasis was laid on the fact that it was quite unnecessary to slow down smoke control programmes because of the excessive cost of fireplace replacements or conversions insofar as open fires were concerned. The film material and mobile exhibition stationed outside the hotel clearly demonstrated that all solid smokeless fuels could be burnt quite effectively and economically on existing approved open fires and, in this way, reduce smoke control programme costs substantially.

A provocative and stirring address was given by Mr. L. V. Penzer, Deputy Director of Marketing of the National Coal Board. This address was followed by question time with a panel comprising Mr. H. Giblin, General Manager of the Solid Smokeless Fuels Federation, Mr. L. V. Penzer, Mr. R. Pane, Sales Director of Coalite, and Mr. R. J. Taylor, Deputy Marketing Director for the North East Area of the National Coal Board, who answered questions relating to problems of supply and delivery of solid fuels in smoke control areas, freedom of choice for council tenants, the identification of fuels contained in bags, the cost and use of solid smokeless fuels and other miscellaneous matters relating to smoke control generally.

After cocktails, the meeting was entertained to lunch at the generous invitation of the Solid Smokeless Fuels Federation, at the conclusion of which the joint chairmen of the bodies attending gave closing addresses. Councillor Mrs. J. M. Scott-Batey, the chairman of the Joint Clean Air Committee for the North East, gave a brief account of the history and functions of her committee and expressed the hope that what members had seen that day would enable them to use their influence in their authorities to ensure a continuation of smoke control programmes. Councillor L. Poole, B.E.M., J.P., chairman of the Northern Division of the National Society for Clean Air, emphasised the basic importance of housing and environmental health as vital functions of local government and reminded members that air pollution abatement was an equally vital ingredient of environmental health. Smoke control could be, he said, linked with modernisation of council houses and he too urged both central government and local authorities to adopt a more positive and purposeful approach to the pursuance of smoke control programmes. Both speakers ended by expressing thanks and appreciation to their hosts, the Solid Smokeless Fuels Federation, for the lavish hospitality which everyone had enjoyed.

L. Mair
Hon. Secretary

EAST MIDLANDS

A combined meeting of the East Midlands Division, with the East Midlands Centre of the EHOA was held at Leicester on 25th November 1975.

The meeting was arranged to mark the completion of Leicester's Clean Air Programme on 1 November 1975 and was preceded by a luncheon kindly provided by the Lord Mayor of Leicester at which representatives of the City and of the two organisations were present, together with Dr A. R. Meetham. In the Chair: Mr John Marriott, FEHA, President of the Environmental Health Officers' Association.

Amongst those present were Dr A. R. Meetham (who carried out the well known survey of air pollution in Leicester from 1937/39); Mr G. A. Hiller (former Chief Public Health Inspector of the City and Chairman of the Division 1959/60); and Mr Sam Cooper (a former Alderman and Lord Mayor of Leicester who was Chairman of the Division in 1954/55).

The Lord Mayor of Leicester, Councillor Mrs Lily Marriott JP, extended a Civic welcome to those present. The Lord Mayor said that in a time when local government was being criticised in the national press, and ratepayers tended to forget the effects of inflation, it was important to get priorities right. It was thus satisfying to think that Leicester got its priorities right in 1958 when smoke control began. Leicester was one of only three cities in the United Kingdom to have completed its smoke control programme and it was felt that the money had been well spent. The Lord Mayor paid tribute to the skill, interest and dedication of the officers and to the co-operation of householders and industry. A special welcome was extended to Professor Lawther and to Dr Meetham.

The Chairman, replying on behalf of both the National Society for Clean Air and the Environmental Health Officers said it was a delight to celebrate with the people of Leicester their wonderful achievement and thanks were due to those who introduced the idea. In thanking the Lord Mayor for her charming welcome Mr Marriott said he would also like to thank the City Council for the facilities placed at the disposal of the visitors.

Mr C. W. Stacey, DFC, Chief Environmental Health Officer for the City of Leicester said he would like to set the scene for Professor Lawther and recalled the beginnings of the programme in 1958, paying tribute to Mr Hiller whose vision and tenacity had contributed so much. Mr Stacey gave details of costs as estimated in 1958 (£143,000) and final costs of £315,000. In addition, Central Government had paid £420,000. The work had extended to 92,000 premises. Mr Stacey traced the changes in heating trends and the various problems met, together with some lighter aspects of the work including the story of the householder making dark smoke by burning old boots—(a point used later at several points by Professor Lawther to season his address). Mr Stacey reminded his audience that industrial smoke had also been tackled. Some 101 hand fired boilers had been dealt with and the City's 26 Cold Blast Cupolas reduced to 14. Leicester had been within a 'black area' as defined by the Beaver Committee. Smoke and sulphur dioxide concentrations in 1962 were 110 and 171 microgrammes per cubic metre respectively, but in 1974 had been reduced to 38 and 84. Buildings had been cleaned and the Town Hall was but one example. Mr Stacey concluded by paying tribute to the co-operation of the fuel agencies some of whom were represented at the meeting.

Professor P. J. Lawther, MB, DSc, FRCP, Director of the Air Pollution Unit of the Medical Research Council and President of the National Society for Clean Air, then addressed the meeting on "The Lessons of Leicester".

Professor Lawther said that this was his first extramural Presidential duty and it was a great honour for him to be present on such an historic occasion and join in the rejoicing. In medicine there was no such thing as history; we were all part of a continuum, and those who did not look back with humility missed a great deal. Dr Meetham ought to be giving the talk. The greatest value to Professor Lawther had been to read yet again Dr Meetham's report. The story of the survey of Leicester—a reasonably discrete medium sized industrial town—needed charting to tell us what we needed to know to bring us to this day. The lesson was there but the lesson was not heeded.

Professor Lawther then quoted from Dr Meetham's Report—"The Deposit Gauge is rather like a thermometer hanging from a tree in a garden. The owner may read the thermometer accurately, but may find he cannot state to what this temperature refers. It refers to the mercury in the bulb of the thermometer, and that alone. It is not the air, the tree, the garden, the sunshine or the radiation from the earth or sky whose temperature is measured, but some compound of all these things. Nevertheless, the thermometer reading may help him in deciding whether to plant out seedlings or whether to have tea served out of doors.

Similarly the deposit gauge measures no more than the rate of deposition of pollution in a bowl of 12 inches diameter. After considerable calculation and research, it is now known that the difference between two consecutive monthly deposits is associated with

rainfall,
wind direction,
turbulence,
trends—steady increases or decreases, } in emission by chimneys
seasonal variation, } in emission by chimneys
irregular variations, } in emission by chimneys
and possibly other factors.

The difference between two simultaneous deposits at two different places, on the other hand, is associated with the very elusive problem—"Which particular chimneys affect any given deposit gauge?" It is inconvenient that deposits are influenced by so many factors, but individual items on the above list may help to provide useful information. The effect of wind direction, for instance, may be valuable evidence about the direction from which a particular deposit originates. Also, like the thermometer above, a deposit gauge has its general uses. It may be a help in deciding the best site for a house or a cricket ground; or whether to install a drying machine in a laundry.

Little was known about the distribution of smoke in towns and there was doubt about the place of origin. Information was needed in the rebuilding of the bombed areas. How much smoke? How was it distributed? Where did it arise and when? The clear definition of the questions to be answered and the setting out to answer them was in contrast to the present practice of feeding information into a computer and producing some conclusions from what came out. Illustrating his talk with slides Professor Lawther said that it seemed incredible now that some of the questions needed to be answered—especially to some people who thought that they had discovered air pollution. 'Air Pollution in Leicester' was a report on a town which was not in a conurbation. One of the by-products of the Report was the National Survey of Air Pollution begun in 1961 and based on recommendations in the Report. The Deposit Gauge was banished because it did not measure particles which would be retained in the respiratory system. It was meant to assess nuisance.

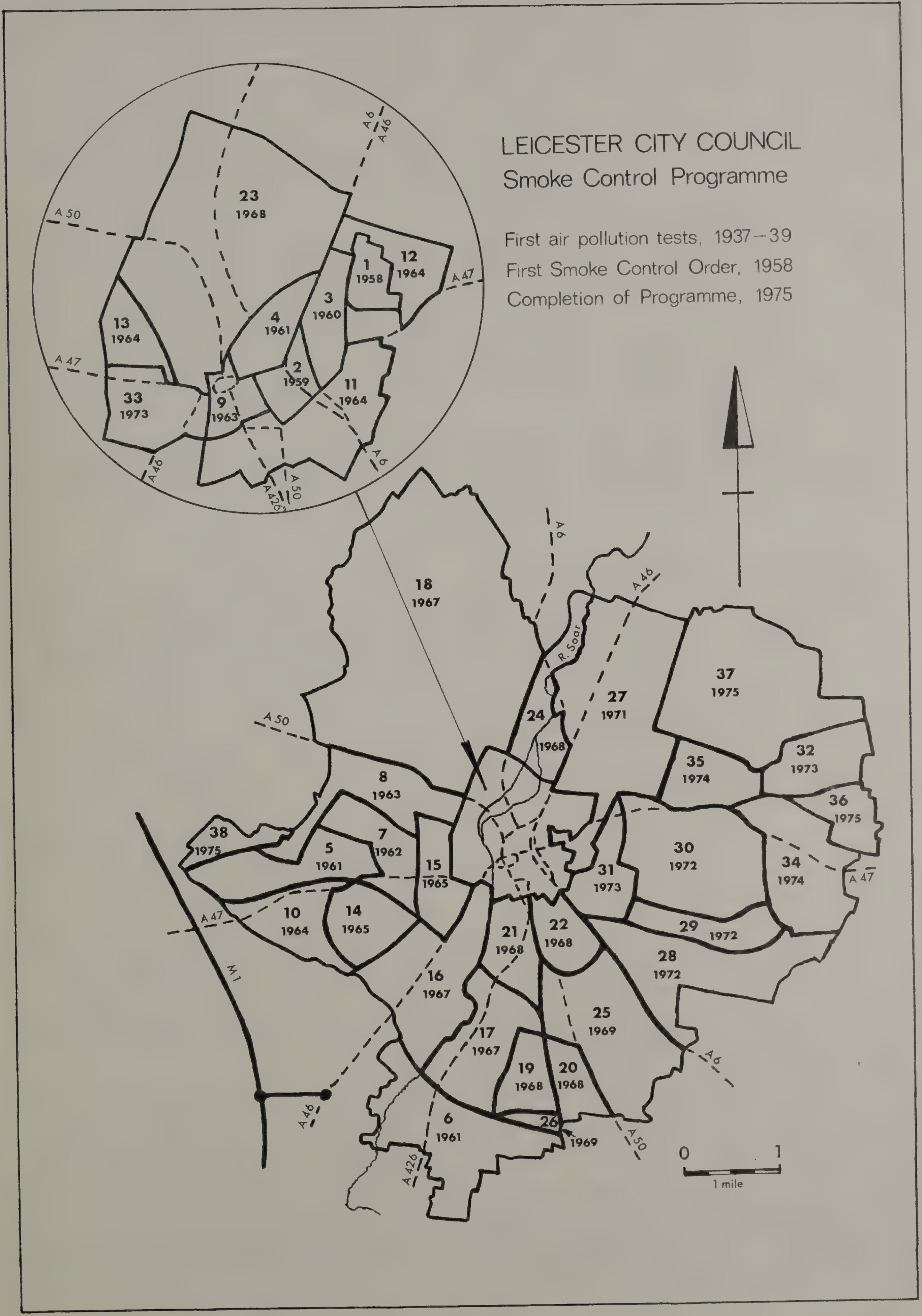
The Deposit Gauge had been preceded by the Owens Automatic Filter which dated from 1918. Another instrument, the Lead Peroxide Candle had also been banished for the wrong reason. It gave an idea of the SO_2 level but it was banished because it was not good at identifying so much as integrating. It enabled users to find the rate of corrosion or build up. There were fifteen Daily Volumetric Filters in Leicester. The inverted funnel ensured that only particles which could be taken into the depths of the lungs were drawn in. More versatile instruments were available for SO_2, one example of which was designed to measure the rate of increase in conductivity in a cell containing dilute peroxide. There was also the cascade impacter and thermal precipitator which had been used in work in mines. The electron microscope was needed for particles less than one micron, which were small and varied in nature.

Domestic coal burning was not being included since this was destructive distillation rather than combustion, with emission of an aerosol of tar which had no specific particle size. It was aerodynamic but did not allow of a decision whether it would be retained in the lung. A typical particle was knitted very tightly and remained with the carbon particle stuck to it. A typical magnified smoke particle has an enlarged surface for little mass, i.e. a large surface to weight ratio. There could be gases adsorbed and these were not scrubbed out.

Acid particles had been described by John Evelyn in 1667 who deduced their existence by the unpopular process of thinking. They had to be there. Owens demonstrated them on a gelatine film. An electron micrograph of Sulphur Acid particles had been made. These might be important whenever breathed. So far they had produced no effect. Such particles grew in a warm moist climate.

A picture taken in Leeds gave the impression of smoke from domestic fires at lung-level. Smoke control was an outcome of Meetham. A picture of Stoke-on-Trent showed the different nature of smoke from kilns. Blue brick kilns possibly showed industry at its worst where a poor combustion process was purposely used.

Looking at trends, measurements had been taken in Kew since 1924 and the five year mean values showed smoke horrifically high. The Leicester Survey showed 300 microgrammes/m^3 but the figure came down after the war. The



LEICESTER CITY COUNCIL
Smoke Control Programme

First air pollution tests, 1937–39
First Smoke Control Order, 1958
Completion of Programme, 1975

Leicester figure was the same as City Hall in London, but nothing like as bad as Stoke. It wasn't chosen because it was the worst city. Diurnal variations in smoke found out where it came from. There was a notion that it blew horizontally. It was both exotic and native. When fires were lit it drifted in and consisted of both industrial and domestic smoke.

The smoke to sulphur dioxide ratio was used systematically in all abatement work and this had altered very considerably.

A view of pollution in Piccadilly Circus in 1957 was of interest. This was brought about by pollution up aloft due to smoke from London being subjected to increasing turbulence, and then being met by a contrary wind causing it to bank back. This happened at a Sunday lunch time when people would be cooking a meal and heating an extra room.

Measurements taken over a 56 hour period in 1957 on the roof of St. Bartholomew's showed how small changes in wind direction could affect readings, at one time bringing smoke drifting from the East End and then changing to bring emissions from the West End where fuel tended to be burned more efficiently.

Dramatic differences were evident between Stoke in 1910 and 1968, dating from a time when industrial zealots were not ashamed of "where there's muck there's brass" to an appearance almost of a ghost town. In 1932 Kensington had more fog than Rothampstead. By 1962 they had changed places due to the decrease in fog frequency in the towns.

Professor Lawther then turned to the 1952 London smog, and the increase in deaths which followed that episode. The smoke figures must have been a gross under-estimate since it had been necessary to scrape off the smoke with a razor blade to get a reading. It must have been more than 10 milligrams per cubic metre. A performance of La Traviata at Sadlers Wells had to be stopped because the audience could not see the stage.

In a sustained survey chest clinic patients were asked to record daily how they felt. Cynics who alleged that the diarists would be influenced by the weather should note that on a day when there was no reading there was a wet fog—circumstances providing relief to the chronic bronchitic. As the years had passed the peaks on the graphs of these recordings had gradually disappeared.

The Beaver Committee had, incidentally, been wrong in suggesting that SO_2 would not be affected. With the removal of smoke more sun reached the earth to warm it and to cause the air to rise.

Posing the question "What is it in the air that causes bronchitis?" Professor Lawther showed a normal lung section and that of a bronchitic. Could the blame be put on air pollution? Charles Daly designated towns on coal consumption and found that it did not produce a relationship in checks on 5,600 children with previous upper respiratory tract infections. This left the problem of pollution from road traffic. Something was getting at children in the first nine months. The youngest smoker they had found had been 18 months old, so that it could hardly be said that exhaust fumes were getting at people before tobacco! In a test to see if it mattered whether a young person was born before or after the 1952 smog, 800 in each category were checked in Bromley, Camden and Southwark. It was found that there was no difference in breathlessness at 18 + (pre smog) and the 800 born post 1952.

When, however, smokers were compared with non smokers (both male and female) there was an all too clear difference. Similarly cough and phlegm showed no distinction between pre and post 1952, but again was marked in smokers as opposed to non smokers. The distribution of the tests was such as to exonerate air pollution.

In comparing urban and rural it was noted that mortality figures for bronchitis in 1901 in London were twice those for rural areas. Five years later the London figure was approximately the same as the rural and in 1916 they were almost exactly equal. With the advent of antibiotics the rural figures were shown to be falling. Finally, though amounts of benzo-a-pyrene in the air were less, lung cancer was still increasing in both rural and urban areas. It was slacking off in London amongst men but increasing dramatically in women. It was sad to have seen us triumph over one form of pollution only to see it being supplanted by another—self inflicted!

Following sustained applause, indicating the enthusiasm with which the address had been received by his audience, Professor Lawther dealt with a number of questions.

On vehicle exhausts Professor Lawther said the sensible approach was to do what a prudent man would do. Exhausts never did anyone any good but one needed to be very careful in maligning the diesel, which was very good when well maintained and disgusting when not well maintained. The diesel did not appear until the 1930s. Every year the whole of the London Transport personnel were looked at but mortality figures had shown no evidence of being affected by exhaust pollutants. Diesels burnt a clean mix and made little carbon monoxide. It was interesting to note that CO went down during petrol rationing. The researchers had carried out long and careful experiments in gassing themselves. In 211 times in 1974, 3% saturation had not been exceeded, yet 16% was found in a woman smoking in a hospital ward. CO was a pollutant for which there was no threshold value.

Referring to lead, Professor Lawther said there was no evidence of harm from lead in vehicle exhausts, but again from the point of view of the prudent man there was no sense in digging up a toxic metal and spreading it about. Recently samples of blood taken from 58 school children had been tested for lead and gave a mean value of 9·6 microgrammes per 100 ml, but one had only 4 microgrammes—yet he breathed like other people.

Professor Lawther agreed with comments that we should not regard the battle as won. It was important that none of us should go to sleep or wallow in self satisfaction. There were two recent lessons on pollutants in small quantities namely, crocidolite and vinylchloride which produced cancer of the lung and liver respectively. Iron oxide on the other hand had never been shown to produce any effect on the lung, but there ought to be a new era of emphasis on STRESS. Some people could not take any more stress and psychiatric depression was the most painful disease known to man.

Professor Lawther also agreed that the increased incidence of lung cancer in rural areas could be accounted for to some extent by commuters and said the whole question was confounded by migration. Cigarette smoking was originally an urban habit. After the first World War people who came back inseminated the towns. The rural man smoked a pipe. Migration had an effect without a doubt. Where there was a long incubation period the lag would be seen. Lung cancer needed 20 years and could be up to 40 years.

In thanking Mr Stacey and Professor Lawther, Mr J. Jones, Director of Environmental Health, City of Lincoln, and Chairman of the East Midlands Division of the Society, said he felt proud that Leicester was in the East Midlands Division and hoped that other towns could emulate Leicester's example. Thanks and congratulations were due to the officials of Leicester City Council who had arranged the meeting. Turning to Professor Lawther, Mr Jones said he had known the meeting was in for a 'treat', having had the pleasure of hearing Professor Lawther recently at Brighton. Professor Lawther was known for his ability to speak on matters of great scientific content and interest in a style flavoured with humour and a great amount of common sense—something we sometimes looked for in vain.

E. F. Raven
Hon. Secretary

Derby's Assistant Environmental Health Officer, Mr. E. F. Raven—the man who implemented smoke control in Derby —has been elected a Fellow of the Association of Environmental Health Officers in recognition of his work particularly concerning clean air.

Mr. Raven joined the local health department in 1950 and eight years later was appointed Senior Public Health Inspector with responsibility for atmospheric pollution.

When local government was reorganised, Mr. Raven was appointed Assistant Chief Environmental Health Officer (pollution and noise).

During his time at Derby he has been responsible for Derby's smoke control programme and all other clean air legislation in the town.

Mr. Raven is secretary of the East Midlands division of the National Society for Clean Air, vice-chairman of the Derbyshire branch of the Environmental Health Officers' Association.

SOUTH WEST

Avon and Gloucestershire Environmental Monitoring Committee

Shortly after local government reorganisation the Chief Environmental Health Officers of the twelve District Councils in the Counties of Avon and Gloucestershire met to discuss environmental pollution monitoring and, as a result, decided to set up a Working Group of second and third tier Specialist Officers from each of the Districts in order to consider:

1. The past involvement of local authorities in monitoring and the methods used.
2. The monitoring needs of the districts.
3. Future monitoring methods.

As Bristol had been involved in air pollution monitoring over a long period of time and had recently been analysing future needs and developments, I was given a watching brief on this Group and it was also suggested that it should be steered by specialist staff from the Bristol Department. The Group first met towards the end of September 1974, and Mr. L. E. Robson, the Principal Environmental Health Officer—Environmental Control, and Mr. P. Cooper, Senior Environmental Health Officer—Environmental Pollution and Noise Control, both of Bristol, were nominated as Chairman and Secretary of the Group respectively. As all Working Groups appear to need a means of identification, the title of "Avon and Gloucestershire Environmental Monitoring Committee" was adopted. It should be emphasised that this is a Working Group of Officers only. The Group was established as a matter of priority and it was envisaged that it would carry out an on-going exercise to review methods of environmental pollution monitoring, to advise participating authorities on the available methods of monitoring environmental pollution, including noise. The Group is completely independent, is free to exercise its initiative in considering and developing new techniques, and it is intended that it will be free to liaise with any other interested bodies. It was decided by the Group that one common project should be developed which would enable all the participating authorities to work together; at this point a representative of the Public Analyst and Chief Scientific Adviser's Department for Avon and Gloucestershire was involved.

The work so far has resulted in a scheme to monitor a number of heavy metals, in particulate form in ambient air in Avon and Gloucestershire. It should be noted that in keeping with the current financial climate in local government, this was to be essentially a low cost exercise and the monitoring and analytical techniques used bore this principle very much in mind. It is also possible that District Councils in the County of Somerset may also participate.

Methods

1. Moss bag monitoring, incorporating sphagnum moss in hair nets.
2. High volume sampling, through a millipore filter.
3. Tak bags (Takrag resin-impregnated material).

Project Objectives

1. To obtain a comparative metal concentration in the results obtained with the moss bags.
2. To correlate, where possible, the concentrations of the metals in air given by the high volume sampler with the moss bag and the Tak bag figures at the same site, i.e. the principal site.
3. To assess the effectiveness and/or differences of the three methods of monitoring.
4. If correlation is satisfactory, to relate all the metal concentrations in the moss bags of all 10 sites and the Tak bag on the single site to the high volume sampler, thereby arriving at ambient air concentrations of the metals in the ambient air in $\mu g/m^3$ and to subsequently relate these results to 1/40 of the T.L.V. values.

Scheme

Each District will choose 10 monitoring sites, one principal and nine secondary sites. At the principal site will be the high volume sampler surrounded by five moss and Tak bags, and at each of the nine secondary sites will be five moss bags spatially arranged in a small area. All sampling points, whether moss bag or high volume sampler will be 1½ metres above ground level.

Moss bags and Tak bags will be changed every month and high volume filters every four days. The moss bags in their entirety (moss plus hair nets) and the filters (where necessary) will be supplied by the Laboratory every month and exposed samples will be forwarded to the Laboratory every month. The five moss bags per site will be combined as one sample for analytical purposes. Each month, therefore, each District will have 10 moss samples (50 moss bags) and seven/eight filters for submission, plus one Tak sample (consisting of 5 Tak bags).

Each District will have to equip itself with the following items which make up the high volume sampler.

1 × M361 Pump (mounted)
1 × "Gas Board" Meter
1 × Millipore Filter Holder
1 × 1 Millipore Adaptor (37 mm)
Tubing, filter funnel, etc.
Housing for the above equipment

Detail

Each moss bag will contain 0·6g sphagnum moss which will be collected and specially washed by the Laboratory. The position of each bag will be carefully chosen so that it is not in a windy position. Each Tak bag will expose a predetermined area of Tak material.

The high volume sampler site will be chosen so that it is run off the mains supply (otherwise M371 pump will be necessary in place of M361, plus a heavy duty battery).

The metals which will be determined by both techniques are lead, zinc, cadmium, copper, iron, vanadium, manganese, chromium, aluminium, plus any others specified by a local authority. Weather data will also be recorded as part of the exercise. The filters for use in the high volume sampler will be 37mm diameter, $0 \cdot 8\mu$ Millipore.

Conclusions

This is a low cost exercise which will provide a vast amount of useful information. It is also the first attempt to correlate the moss bag and Tak bag techniques with that of high volume samplers in order that a real assessment may be obtained of the air concentrations of those metals which are important environmentally. This will also help local authorities who previously have carried out limited air monitoring to establish their "hot spots", which may then be further examined in detail by the individual authority.

This scheme will enable local authorities to identify areas which require further investigation and if an authority is in the enviable position of having no such areas, it will at least establish base levels of air pollution in the area. There has been liaison with the Department of the Environment and Warren Spring Laboratory from the outset in the development of this scheme in order to ensure that it is in line with national thinking and developments with regard to air pollution monitoring. At the time of preparing this paper all the 12 District Councils in Avon and Gloucestershire, and two District Councils in Somerset have agreed to participate and have either taken delivery of the necessary equipment or have placed orders for it.

It was originally envisaged that all the samples would be handled at the Bristol Laboratory of the Public Analyst for Avon and Gloucestershire, but since the participation of Somerset authorities there has been agreement between the Public Analyst of Somerset and the Avon and Gloucestershire Public Analyst with regard to the sharing of work and, more important, for suitable cross checks on analytical procedures to be carried out.

Data Handling

All the results will be sent from the Laboratory to the individual District Councils with copies being sent to the Bristol office to the Chairman of the Committee. The Committee will assess the results involving such additional expertise as may be necessary and it is probable that the information will be processed on the programmable calculator already used in the Bristol Environmental Health Department, so that such items as averages and highest and lowest levels etc. can be computed and the data summarised and processed as necessary. The Committee will prepare reports on the work for the participating authorities and subject to their consent this will be published after a suitable period of operational experience, say 12 to 18 months.

M32 (PARKWAY) STUDY

A major motorway link (M32) with the M4/M5 motorways and the City's Outer Circuit road is being developed. Part of this link is already completed and in operation but another stage of this motorway is now nearing completion, and is due to open to traffic in May/June of this year. This stage, part of which is elevated, takes the motorway through a densely populated residential area, and it was considered that this presented an ideal opportunity to monitor the environmental effects of this motorway, particularly as there was time to carry out monitoring before the road was open to traffic. This idea was discussed with the Department of Health and Social Security, the Department of the Environment and Warren Spring Laboratory, all of which were of the opinion that this study was a valuable exercise and would make a significant contribution to national as well as local knowledge.

It was decided to monitor the effects on the population living within a 100 metre band on each side of the motorway and that the following should be monitored for lead—air, dusts, soil, vegetation. At the same time, blood lead surveys would be carried out, noise levels monitored and weather data recorded. The first phase of this monitoring is now in operation and will be completed before the motorway opens, and it is intended to repeat the exercise six months and 12 months after the opening of the motorway. At the same time a similar exercise is being carried out in a control area which has been carefully matched in terms of housing density, social structure and all other relevant matters, except that it does not have a motorway running through the middle of the area. In both areas there are some 500 households, and as a result of a house-to-house survey some 400 co-operative households have been identified in each area. In the area in the immediate vicinity of the motorway, four monitoring sites have been established at which high volume samplers with Millipore filters are being operated and at each site moss bags and Tak bags are being used in conjunction with the high volume samplers. In addition there are 15 in-fill sites, each with three moss bags, but with no high volume samplers. The control area has one monitoring site only, at a primary school, at which a high volume sampler, moss bags and Tak bags are being operated. There is one additional control site right away from either the main control area or the area in the immediate vicinity of the motorway, where a high volume sampler, moss bags and Tak bags are being operated. In addition, dust samples will be taken from some 60 sites, and soil samples to 3 in. depth will be taken at 20 sites. A blood lead survey will be carried out in both the control and the principal areas involving children from 0-4 years of age, and 5-10 years of age, and women in the 20-50 age group. In each case 24 women and 24 children from each age group will be selected in each area.

As already mentioned, the significance of this study is seen that monitoring can be carried out before any traffic passes along the motorway, so that a true assessment of the impact of such an urban motorway can be assessed.

These are the main examples of a co-operative approach to environmental problems, but in recent months the City Council has initiated and been involved in another project which involved co-operation between a number of authorities, and which might be of interest to the Conference—the monitoring of traffic-generated air pollution and noise around a primary school in the city.

This arose from parents' concern and representations which were made with regard to the effects of road traffic noise and air pollution on children and staff at a primary school which as a result of traffic management schemes occupied a triangular island site, bounded by three major roads. A major diversion had also greatly increased traffic flow on these roads which form one of the city's major commuter routes. Major problem areas were identified after discussion with the District Community Physician of the Avon Area Health Authority and the Chief Scientific Adviser of Avon County Council, and as a result it was decided to monitor lead, carbon monoxide and noise.

Lead was monitored by means of high volume samplers with Millipore filters both internally and externally at the school, and at another school approximately half a mile away which was used as a control site. Monitoring was carried out continuously during two periods of the day, from 08.00 to 16.00 hours and 16.00 to 08.00 hours, so that the actual levels to which children and staff were exposed could be identified. Blood lead levels and carboxyhaemoglobin levels were also measured and blood samples were taken from 12 children (six male and six female) in each of the following age groups, 5-6, 6-7 and 7-8. It proved virtually impossible to obtain a control group of children matched in all respects except school, and because of this it was decided to use the data obtained from control children used in the blood lead survey carried out in 1974 for the purposes of the Avonmouth pollution problem. Carbon monoxide was monitored at the island site only, using a continuous carbon monoxide analyser used in conjunction with a chart recorder. Carbon monoxide was monitored continuously throughout the 24 hours.

Traffic noise was also monitored, both internally and externally, and noise levels were computed on L.10 basis in accordance with the Noise Insulation Regulations. Details of traffic flow were obtained and weather data recorded.

At the time of preparing this paper the results of this exercise are still under evaluation.

D. J. Barnett
Hon. Secretary

"Air Knows No Frontiers"

INTERNATIONAL NEWS

SWITZERLAND

Two Swiss scientists have prepared an air pollution map of Geneva and its surrounding canton based on a two-year study of the growth of lichens. Ringed areas on the map show progressive improvement in air quality as one moves away from the city centre.

Different lichens can tolerate different levels of pollution. Some types become sterile and die at the first contact with polluted air, while others are quite sturdy. Lichens are rare in the city centre despite Geneva's relatively clean air, parks, waterways and prevailing winds. Their findings showed that wooded areas provide a strong brake to pollution effects.

The presence of mercury residues in Lake Geneva is currently a cause of public concern. There are various mercury sources—the Lausanne conurbation discharges between 40 and 80 kg. every year, while large quantities are carried into the lake by rivers, such as the Dranses. Similarly, chemical plants use mercury, and a daily loss of 710 grams is recorded at Monthey: a new process, which relies less on mercury, is to be introduced, and will cut the loss to 50 grams a day when it becomes operational (in principle in 1976) (Nuisances et environnement, October 1975) (Council of Europe Newsletter).

EEC/BRUSSELS

On 7 December 1975 the EEC agreed to a compromise on environmental policy which will allow emission standards and water quality standards to co-exist.

The compromise will permit Britain and other countries who want to practise water quality monitoring to do so if they can show their particular system is effective. Meanwhile, over the next two years, the EEC will draw up precise dumping restrictions for companies and authorities lining Continental waterways. The EEC decision-making council will then have another nine months to approve the ' black-list ' of dangerous wastes to be controlled. This will then have to be implemented during the following two years by those countries not using quality standards. This means, therefore, that the new regulations will not come into effect until 1980.

The EEC have recently issued a Directive about the sulphur content of gas oil, and made a proposal about the restriction of sulphur in heavy fuel oils. Air quality standards for SO$_2$ and smoke are under consideration. A more far-reaching proposal is that of biological standards for lead and screening of the population, which could cause controversy, as Member States will be required to monitor the population by blood sampling. Further proposals concerning lead in petrol and air quality standards for CO and NO$_2$ are under consideration.

JAPAN

Orders for environmental protection equipment which reached a peak in late 1974 have since been declining because pollutants are decreasing. However, the Japanese government's environment-related budget for 1975 was boosted by 34 per cent to strengthen regulations concerning air pollution, and private investment for the prevention of public nuisances during the whole of 1975 was expected to be up by 33 per cent. As a result, demand during the last half of 1975 was expected to recover.

BELGIUM

The World Environment & Resources Council will stage a Conference in Brussels from 5-9 April 1976 to provide input for the Belgian Government's participation in the UN Conference on Human Settlements (Habitat 76) to be held in Vancouver this May.

HONG KONG

The first interim report of the consultants advising the Hong Kong Government on environmental protection outlines recommendations covering water, noise, air and solid waste pollution and aims to provide sufficient information for establishing priorities for the achievement of environmental quality standards within a flexible framework.

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Reader Enquiry Service No. **7610**

The Potential Use of Low Temperature Matrix Isolation Infra-Red Spectroscopy for the Determination of Airborne Amines

by

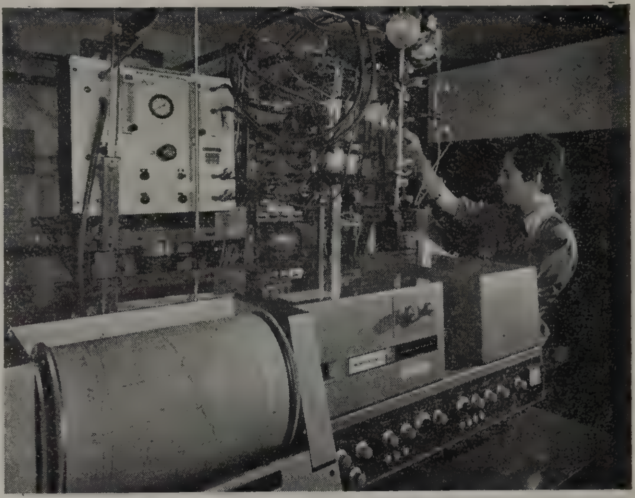
D. F. Ball and C. J. Purnell

(Dr Ball and Dr Purnell are in the Department of Pure and Applied Chemistry at the University of Salford where they are engaged in the measurement of air pollution and toxic hazard for the University Chemical Advisory Service)

Gas analysis by infra-red spectroscopy depends upon the selective absorption of infra-red radiation by the gas. Different gases absorb radiation at different wavelengths although there may be a region of overlap. Thus for mixtures which are of essentially different gases the amount of radiation absorbed at different wavelengths will give an indication of the gas composition.

There is, however, one restriction in that homonuclear gas molecules eg N_2, O_2 have no absorption in the infra-red region of the spectrum. This restriction is often a disadvantage where a complete analysis of say flue gas is required but it constitutes a great advantage in analysing the impurities in air in that the major constituents do not absorb radiation.

In a conventional infra-red spectrometer gas pressures of $\sim$ 80 mm Hg or more in a 10 cm long gas cell are normally used to give a reasonable spectrum. However to obtain sufficient sensitivity for minor constituents of a gas mixture a greater amount of gas must be traversed by the infra-red beam. This can be achieved by either increasing the path length or the pressure of the gas. Both of these techniques have been used, with path lengths of up to a hundred or more metres and gas pressures of about six atmospheres. These give satisfactory increases in sensitivity for heavily polluted atmospheres or for analysing exhaust gas streams and for this reason have been used, for example, for measurements on petrol and diesel engine exhaust and waste gases from incinerators. However, it is not generally suitable for very low concentrations of pollutants in the atmosphere.



Low temperature equipment

Absorption bands of gases in the infra-red are normally broad due to changes in rotational energy occurring at the same time as changes in vibrational energy and, furthermore, line width itself increases as the absolute pressure is increased; this in turn leads to difficulty in trying to sort out overlapping bands in the spectrum of mixtures. The problem is to devise some technique which will vastly increase the amount of pollutant in the beam and at the same time also reduce the band width. One solution is to solidify the pollutant and then measure its spectrum. Since the density of solids is of the order of 1000 times the density of gases, solidification results in considerable concentration. There is an additional advantage in that the individual absorption bands of solids are often narrower than in gases; this is because the molecules are less free to rotate in the solid phase. This, coupled with the fact that the absorption intensities in the solid are often greater than in the gas, results in absorption being detectable at lower concentrations with less overlapping of adjacent bands. There is, however, a complication in that if the gas alone is solidified, the interaction with similar adjacent molecules complicates the absorption pattern. This can be overcome by dispersing the gas in an inert matrix as nitrogen or argon. The basic theory involved has been discussed elsewhere(1). Whilst most gases and vapours can be solidified using a cell cooled with liquid nitrogen, a much lower temperature is required to solidify nitrogen or argon. This has been made possible by the availability of cryostatic devices to manufacture *in situ* liquid hydrogen or helium and such devices are capable of operating at temperatures as low as −268°C (5K). This technique which may be used to provide preliminary recognition of pollutant molecules has been used for quantitative determination of hydrocarbons by Rochkind(2).

The aim of the work described here has been to try to extend this technique to amines, compounds which are particularly malodorous and are difficult to separate well by chromatography. The start of this work was reported at the Clean Air Conference in 1971(3) and since then this work has been fully reported elsewhere(4,5).

The use of the technique for quantitative analysis depends upon the application of the Beer-Lambert law to the absorption bands of the matrix isolated molecules.

This law requires that

$$\text{optical density} = \log I_0/I = \alpha c l$$

where I_0 = incident radiation intensity
I = intensity of radiation transmitted at peak frequency
α = absorption coefficient
c = concentration of absorbing species
l = path length

For matrix purposes the product cl equals the number of absorbing molecules trapped in the matrix through which the incident radiation from the spectrometer can pass.

Prior to deposition a mixture of known matrix (M) to solute (A) gas ratio (M/A) was prepared. By using pulsed deposition(2,5) of amine-nitrogen mixture onto a cold window at 20K and measuring the absorption led to results which adhered closely to the Beer-Lambert law. It is critical to the application of this technique to quantitative measurement that not only is the Beer-Lambert law obeyed but also that the optical density is independent of the matrix to solute ratio (M/A). On theoretical grounds it would be expected that this would be so provided that the M/A ratio was sufficiently high for the solute molecules to be regarded as isolated. Experiments with ethylamine and ammonia showed this to be the case but with methylamine the strongest absorption band showed quite abnormal behaviour in that the intensity is dependent upon the degree of dilution in the matrix. The use of this band must obviously be avoided for quantitative estimation.

This work demonstrates that in using the low temperature technique for the quantitative analysis of gas mixtures, quite unexpected and anomalous intensity variations can restrict the utility of the method. However, the work again demonstrates the substantial extent to which matrix isolation simplifies the spectrum thus confirming its potential for the identification of molecules of known spectral characteristics in, for example, air samples containing unknown pollutant.

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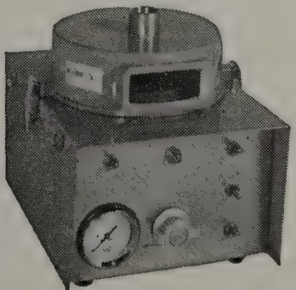

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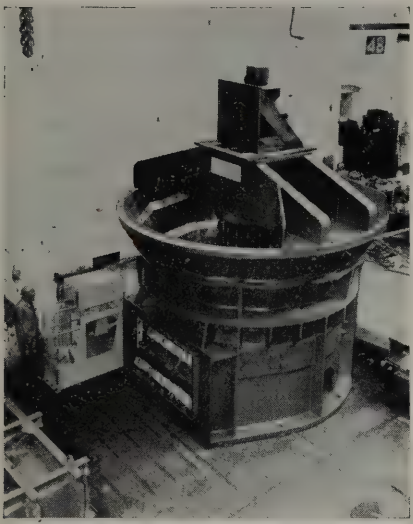
Reader Enquiry Service No. **7612**

INDUSTRIAL NEWS



First Giant Tollemache Pulveriser in the UK

18 months ago a Tollemache Series 92 machine was installed at Charleston, South Carolina and has been pulverising refuse at 60 tph on a double shift basis ever since. As a result three more machines have been ordered for USA installations in New Orleans and Milwaukee. Japan is also using a giant Tollemache 92 for their refuse treatment plant at Highashi, Osaka. Now for the first time a British authority has ordered one of these mills. This pulveriser will be located at Burgess Hill for West Sussex County Council, together with one of the popular Tollemache 42″ machines.

Although there have been horizontally shafted giant shredders and impact breakers on the world market for some years, they have, in the main, been used solely for reduction of bulky and industrial waste. It was not until Newell Dunford Engineering Limited designed the Tollemache Series 92 Vertical Shaft pulveriser that a machine was produced capable of successfully treating mixed bulky and domestic refuse.

Recent trials have shown that pulverised refuse is a very effective supplementary fuel for coal fired boilers, cement kilns etc, which is proving a very practicable and economic method of reclaiming energy and disposing of solid wastes.

The Burgess Hill waste treatment complex will also include metal recovery and paper salvaging, and is being supplied by main contractor Motherwell Bridge Tacol Limited with civil engineering by Hussey Egan and Pickmere Limited. Site work is now well advanced and the plant is expected to become operational mid '76.

Reader Enquiry Service No. **7613**

Environment Team at Nottingham University

A team of university scientists is being financially backed by Allied Breweries in their efforts to solve some pressing environmental problems.

Reclaiming the tin content of old cans, monitoring noise levels in factories and the effects of pollution in Sherwood Forest—these are among the subjects which have come under scrutiny by the team at Nottingham University.

Under the title of the environmental studies group, the team is drawn from several departments of the university, and is substantially aided by a grant—recently boosted from £25,000 to £60,000—from Allied Breweries. The 'beer money', as the grant is fondly referred to at the university, has permitted the environmental studies group to undertake research it otherwise could not afford.

Says Dr Bernard Kilkenny, Chairman of Allied Breweries (UK) Limited: "Allied has already spent in excess of £300,000 on internal measures concerning the environment, such as effluent saving, noise reduction and the recycling of waste, but gave the grant to Nottingham University to encourage research work in a wider range of subjects as a further contribution to environmental protection".

"For instance", adds lecturer Michael Henstock, "each year about £17 million worth of tin is lost by people throwing away old cans. They are either buried or burned, and we are trying to find a method of reclaiming the tin content. If we succeeded in retrieving only 50 per cent, we'd save £10 million a year. And the ability to recycle the material would enable us to sell to other markets and that would undoubtedly help our balance of payments".

The expertise of the university has already been of practical use to industry. One local plastics company found their waste was contaminated with copper and could not be used. Members of the university solved the problem by making a simple separator which salvaged the plastic *and* the copper— a total cash saving to the company of £27,500.

And as a complete contrast, the team are also probing the effects of 20th century pollution on Sherwood Forest. About 125 years ago, around 70 varieties of lichen—the tiny plants which grow in trees and rocks—could be found in the forest. That number is now reduced to 16. The team is investigating which trees are most suitable for planting in areas subject to atmospheric pollution.

In at least one area the Allied cash —first granted in 1973——has allowed the team to make a profit. Said Mr Ron Arnfield, Director of the university's Industrial and Business Liaison Office: "The grant made it possible for us to run a four-day course on the recycling and disposal of solid waste. Originally we planned to use part of the grant to underwrite the course, but in the event we made a profit".

A second course followed last year, with half the delegates coming from Europe, and now further courses are being planned. Now the university hopes to set up a Recycling Advisory Centre— a project which has arisen as a direct result of the Allied grant and the conferences that were held.

Reader Enquiry Service No. **7614**

Alaska Noise Control Contract

Acoustic Technology Limited of Southampton have been commissioned by BP Alaska Inc to study noise control at their Prudhoe Bay (West), Gathering System Project in Alaska.

Phase one of the study specifies noise control measures for existing problem areas and will provide relevant data for future equipment installations. Acoustic Technology engineers visited Prudhoe Bay to obtain on site noise measurements on all installed running equipment, most of which is power generation machinery. All installed equipment skids (modules) were also acoustically calibrated.

Phase two of the contract relates to the noise levels from process equipment which is not yet operational.

Investigations of these future noise levels will utilise site visit data, together with information from equipment vendors and Acoustic Technology's own equipment noise data band and prediction techniques. Acoustic Technology consultants and engineers are currently based in Houston, Texas at BP Alaska Inc. headquarters, to ensure close liaison between BP, the design engineers and all sub-contractors.

The overall purpose of the study is to ensure that all facilities comply with the Occupational Safety and Health Act, 29 CFR. 1919.95 (OSHA). Findings will be presented in such a way that the cost effectiveness of the various noise control options can be easily assessed.

Acoustic Technology Limited is now one of Europe's largest independent noise and vibration engineering consultancies, and is also involved in major North Sea oil projects, onshore process industries, noise control in factories and in general industrial noise and vibration research.

Reader Enquiry Service No. **7615**

Automatic Weatherstation Assists Research in Remote Areas

An unmanned, automatic weatherstation, claimed to be the only reliable low-cost system of its type in the world, has been developed for unattended data collection in remote areas. Designed and developed in conjunction with the Institute of Hydrology, Wallingford, the station is suitable for use in areas where access is difficult and adverse conditions prevail.

Typical applications include data collection for hydrology, meteorology, catchment research, pollution, aircraft noise monitoring and many other environmental phenomena.

The rugged design includes seven sensors attached to cross-arms of the lightweight, transportable aluminium alloy mast and a Model M200L data logger manufactured by Microdata Ltd. Signals from the sensors, which measure solar and nett radiation, air temperature, wet bulb depression, wind run and direction, and rainfall are recorded on the 12-channel Microdata logger. The complete station is powered by a NiCa battery housed in the logger which also powers the interface unit's plug-in transducer cards, LED channel monitor display and all sensors.

The logger digitises its input and records these data incrementally in the form of serial 8-bit words, on standard compact cassettes, at a programmable time increment from 2 seconds to 1 hour. The cassettes are read on a translator unit into a computer, minicomputer or calculator where the data can be processed to give, for example, daily estimates of evapotranspiration.

As an alternative, punched paper tape output or teletype hard copy can also be produced by the same reader off-line. C90 casettes store one month's data from the standard weatherstation.

Reader Enquiry Service No. **7616**

How To Save £25,000 . . .

Large and small users of commercial transport throughout Great Britain are paying increasing attention to ways and means of cutting their transport costs.

A leading manufacturer of electrically propelled vans has taken the initiative by showing that, although 'electrics' cost more to buy, the breakeven point comes as soon as 3½ years when 'electrics' begin to show a financial advantage over diesels and this can exceed £25,000 in 15 years. Financial controllers please note, for these figures have been prepared in the context of the savings which would contribute to the Profit and Loss Account of a company and they demonstrate the effect an investment in electric transport has on the future Cash Flow and the Productivity of Investment in the business i.e. the rate of return on capital employed.

Users who keep accurate records of their transport costs may prefer to think in terms of overall cost per mile. Can they get anywhere near 60 miles for £1·00, for this is what an 'electric' might be expected to cost . . . as good as being able to buy petrol for 22 pence per gallon!

A typical delivery van is one with nearly 350 cubic feet of storage space, transporting a payload of 25 cwt. and now available in a two-speed version giving around double the normal speed when travelling the longer distances from depot to delivery area yet retaining all the advantages in the multi stop-start conditions within the lower speed range.

The first step in an investigation is to check on the daily mileages of existing vans and see how many travel less than 50 miles a day. Some transport users may be surprised to find how many come within this category but these, in fact, are the ones which can be replaced by 'electrics' with all the advantages already stated.

At present the swing to electric transport is saving the country a great deal of overseas payments by utilising electric power generated from home-produced fuel . . . coal, hydro and nuclear energy. "A modern power station is twice as efficient as present internal combustion engined road transport (taken as a whole)", said Mr Charles George, Marketing Adviser to The Electricity Council in a recent talk.

The culmination of research into new types of electric storage batteries may eventually more than double the range of existing electric vehicles by the end of the present decade and still further husband the nation's resources. But there is no need to wait, for the good things can all be achieved with the existing equipment. Some authorities predict that the North Sea gas and oil discoveries will not last beyond the end of the present century, so it is vital to use to the full those resources of fuel which are comparatively inexhaustible and so give added life to the limited fossil fuels.

Reader Enquiry Service No. **7617**

Gas Cleaning Plant Contract From The British Steel Corporation

An order valued at more than £1 million has been placed with Peabody Holmes Ltd, by the British Steel Corporation. The order is for the supply, erection and commissioning of a gas cleaning plant for a sinterstrand in the ore preparation plant at the Corby Works, Tubes Division, of the British Steel Corporation.

The key section of the gas cleaning plant is a three-field electrostatic precipitator designed to handle a maximum of 19,540 actual cubic metres per minute of fume from the exhaust main of the sinterstrand. The plant is designed to ensure that the outlet dust burden discharge to atmosphere does not exceed 115 milligrams per cubic metre at normal temperature and pressure.

In addition to the electrostatic precipitator and associated ancillary equipment, the order also includes for the supply of a dust handling and conditioning system. This enables the collected dust to be re-cycled back into the sintering process.

The gas cleaning plant, which is scheduled to come into operation during the spring of 1977, is the second of its type to be installed by Peabody Holmes at the Corby Works of the British Steel Corporation. The first installation came into service in 1971.

Reader Enquiry Service No. **7618**

New Pollution Monitor Equipment

The introduction of their new Model 1100 pollution monitoring equipment is announced by Polkinghorne Industries, the electronics and instrumentation company.

The equipment is essentially a nucleus counter which has been proven over the past three years by British Nuclear Fuels Ltd, and who have now ordered several of the new model. The equipment can have application involving a number of "clean condition" industrial processes, such as laboratories, microelectronics and nucleonics, food and drug manufacture and computer assembly. An interesting application is the testing of the very clean atmospheric conditions required for antibiotic manufacture, as the particles detected by the condensation nucleus counter are similar in size to viruses.

High efficiency particulate air filters find increasing application in the chemical process industries to remove material from process and effluent air before discharge. When high efficiency must be guaranteed, as such is the case in some nuclear process installations, the recognised best practice is to test the filters before installation and also *in situ*. Among various test methods evolved in recent years is the condensation nucleus counter system originally developed by the late Professor L. W. Pollak. Polkinghornes have recently supplied several counter systems to BNFL.

Advantages of the Polkinghorne instrument over other types are that it is extremely compact and portable, being contained in a cabinet only 140 cm high, 46 cm wide and 38 cm deep, and mounted on castors. Thus it can be easily used in any part of a large and complex plant. Furthermore it gives a very fast response, is simple to operate, and is cheaper and generally more convenient than any other method.

The name condensation, or Aitken, nuclei is applied to any particles in the atmosphere within a size range of 10^{-1} to 10^{-4} micron, ie, particles as small as one millionth of a millimetre in diameter. Nuclei of these dimensions cannot easily be detected by light scattering methods, and the principle used in the Pollak counter is based upon a method discovered by Professor Aitken in the late nineteenth century—that of creating an artificial cloud or fog, by condensing water on to the particles and increasing their diameter several hundred times.

The Polkinghorne instrument consists basically of a vertical brass sample tube 60 cm long, machined to close tolerances, and having a wet porous ceramic lining to give a bore of 25 mm. At the top is the optical system constructed to provide a collimated circular beam of white light via a condensor, lenses and a series of stops. At the bottom is a photocell.

A sample of air containing Aitken nuclei is drawn into the tube by suction pump. The tube is sealed at both ends and pressurised. The sample is then left for one minute to allow the nuclei time to reach equilibrium with the water in the ceramic lining.

After one minute the photoelectric voltage, measured in micro-volts, is adjusted to the desired datum. The pressure is then suddenly released and some of the moisture from the tube walls condenses on to the nuclei, causing a mist to form and the light beam to reduce in intensity. After stabilising for a second or two, a further light reading is taken and the extinction figure calculated.

This operation can be manual or semi-automatic, being simply determined by the position of a front panel switch. The automatic sequence is made possible by the use of an integrated circuit timing network. In the automatic mode, digital readout on the front panel indicates elapsed time in seconds; the relevant solenoid valves are operated from the timer. At the end of the cycle the light reading (displayed on a digital panel meter) is held automatically until the timer resets approximately 35 seconds later.

Two other modes of operation are available with this unit: double-tube configuration for simultaneous sampling at two points (say, either side of a high efficiency filter) controlled from one monitor; and remote operation using a duplicate front panel assembly for circumstances where access to the actual monitor is either impossible or undesirable.

Finally, by referring the extinction figure to a set of tables, the number of nuclei present can be read off instantly.

The technique of Pollak counters, originally developed and calibrated for use in meteorology and research into the physical properties of clouds, was first applied to the testing of particulate air filters in 1966. And now, with increasing interest in the method and the proven efficiency of their new "streamline" nucleus counting instruments, Polkinghorne Industries Ltd are investigating further applications.

For example, checking for atmospheric pollution is a subject of importance to local government authorities. In this respect it is known that a quiet village street may have a condensation nuclei count at ground level of about 25,000 per cubic centimetre. A busy town with many diesel engined vehicles may have 500,000 per cc or more.

The efficiency of the nucleus counter made by Polkinghorne Industries Ltd can be gauged against its ability to record a mere 15 nuclei per cc downstream from a high efficiency particulate air filter.

Reader Enquiry Service No. **7619**

New Oil/Water Emulsion Burner for Heavy Fuel Oils

A new oil burner which incorporates a revolutionary method of utilising low cost residual oil to give efficient, clean combustion characteristics approaching those of light fuel oil has been introduced to this country by Weishaupt (UK) Limited, a subsidiary of Max Weishaupt GmbH, West Germany.

Called the Emulsion burner, it is one of the first of its type in the world, and is so called because it uses a mixture of residual fuel oil and water. It may be used on installations which formerly were only considered suitable for light fuel oil (35 second), and its introduction to this country follows ten years' research and development and several years of successful field trials on the Continent.

The advantages of the burner are many. Significant savings in fuel costs can be achieved, and deposits on the boiler heat transmission surfaces are lessened, thus improving the efficiency of the system and reducing the number of times the boiler needs to be cleaned. This saves costly labour and avoids unnecessarily frequent periods of equipment downtime. Systems which burn residual oils sometimes need to be cleaned as much as once per week, but in recent field trials, installations have been run using the Emulsion burner which required to be cleaned only three times in a year.

Pollution is also lessened, due to the reduction in stack solids, and this will be an increasingly important factor as countries become more aware of environmental control.

It has been known for many years that the addition of water to heavy oil improves its combustion characteristics by enabling more complete combustion to take place. The Weishaupt Emulsion burner is one of the first in production to utilise this principle, and consists basically of the single- and two-stage 'Monarch' burner to which is attached a water supply unit.

The residual oil is drawn from the tank, heated and pumped through a normal burner ring main system until it reaches the fuel pump which supplies the nozzles. At the same time, water is routed through to the pump where it mixes with the oil to form an emulsion, the ratio of oil to water being about 3 to 1. This emulsion then flows via the solenoid valves to the nozzles, resulting in a uniform and efficient flame with greatly reduced soot and flue gas solids.

Many safety features are incorporated in the burner and water system. The water unit is connected to the main water supply, and a non-return valve prevents the oil from entering the water system. The water is filtered and softened if necessary, and a reservoir and pump are provided for water pressure regulation. Safety shutdown of the burner is effected by a photocell sensor connected to the control box.

Weishaupt manufacture an extensive range of burners for many applications, ranging from 66,000 BTU/hr to 64·5 million BTU/hr. All components are tested before assembly and delivery.

Reader Enquiry Service No. **7620**

Irathane 118
Outstanding Resistance Against Chemical Attack

Now available from Irathane International is Irathane 118, a highly resistant elastomeric polyurethane coating designed to provide excellent resistance against chemical attack in fume, splash and total immersion situations.

Typically, applications envisaged for Irathane 118 include: corrosive fume hoods and exhaust fans, chemical storage and mixing tanks, wet scrubber systems, thickening and water classification equipment and chemical processing equipment.

Irathane 118 is one of a family of unique liquid polyurethane systems which will overcome most abrasive or corrosive problems where the surface can be protected with a sprayed lining. In many applications in North America and Canada, Irathane systems have demonstrated an up to ten times better wearing life over conventional rubber and metal alloy. They combine the toughness of linear plastics with the resilience of soft natural rubber.

Using this liquid system offers a number of significant advantages. It is easy to apply, easy to mix and it will cure at ambient temperatures. Furthermore, it can be bonded to a wide range of materials, ie, concrete, wood, vinyl, metal, ABS, GRP and rubber—withstanding temperatures of up to 90°C in many instances and therefore providing substantial economies over rubber lining and conventional bake-on coatings. Its inherent flexibility eliminates the problem of cracking or crazing which is prevalent among rigid coatings and lining materials.

Reader Enquiry Service No. **7621**

New Centramatic Oil-Fired Boilers

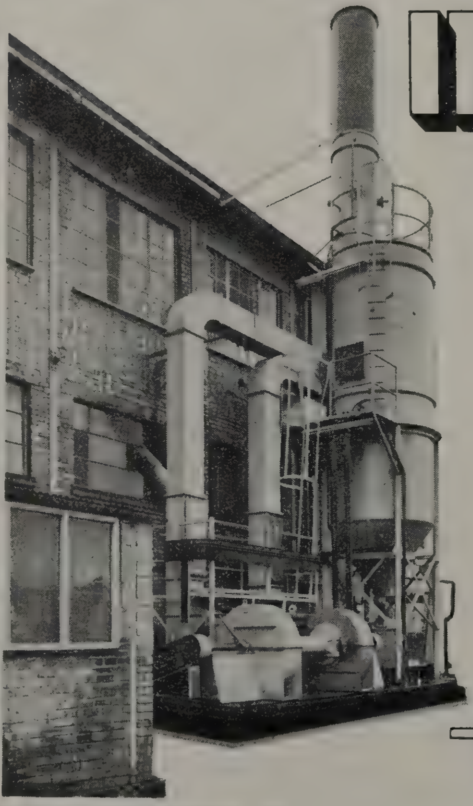
Two new generation oil-fired boilers, the Centramatic 13 and Centramatic 17, are being introduced by Redfyre Ltd early in April. Giving 12·3 kW (42,000 Btu/hr) and 17 kW (58,000 Btu/hr) respectively, these replace the existing models and incorporate a number of improvements.

The most obvious is the introduction of a rectangular heat exchanger in place of the previous design of radially disposed vertical water tubes connected by top and bottom water tanks. In the new models the waterway encloses all sides of the combustion chamber except the front. A stainless steel baffle, open at the base but closed at the top, allows full flame development and ensures an efficient scrubbing of all surfaces. The baffle is withdrawn for servicing so that the cleaning and inspection of the surfaces is simplified.

The front cover of the heat exchanger is backed by a 30 mm (1 in) slab of insulation which limits noise and forms a seal with the outer edges of the baffle while asbestos rope seals the junction of the cover and the front edge of the waterway. Slabs of insulation are fixed to the sides of the boiler body.

While the well-proven fan pressurised vaporising pot burner is retained, the ignitor is now sealed into the pot by a ring washer and metal clip. This ensures that any replacement is correctly positioned, so reducing the chance of premature ignitor failure. At the same time the coaxial fan which forced combustion air into the pot is replaced by a quieter centrifugal type and this is now sited on the top of the boiler to avoid possible 'linting' of the impellor blades. Combustion air is now fed down through a duct beneath the fan into the burning chamber.

In the new models the DAS auto-



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Reader Enquiry Service No. **7622**

matic control box and its transformer are fitted in the lower section above the oil control valve instead of at the top of the boiler. It is carried on a hinged pivot so that it can be swung forward through 90° bringing it outside the boiler to give immediate access and permit the burner chamber door to be drawn out for servicing. Re-siting the control box leaves space above the boiler for a pump to be fitted within the casing.

Both boilers are slimmer than the previous models, being only 407 mm (16 in) wide with a height of 900 mm (35½ in) and an overall depth of 553 mm (21¾ in) to the edge of the front trim. In both, the control panel has a graphite and anodised aluminium finish and carries the thermostat control, limit stat warning light, lockout light and is available with or without the programmer. As in all Redfyre boilers the programmer models have the programmes offered printed on the panel.

The boiler body is provided with two 1 in B.S.P. tappings at each side for flow and return and, since the pump can be fitted within the casing, an additional ¾in B.S.P. tapping is provided at the top of the waterway for its connection.

Both boilers burn 28 second kerosene and are approved by DOBETA. Both appliances are also supplied full pre-wired with a terminal block provided for connection of the mains electricity supply. In each case all servicing can be carried out from the top and front of the boilers so that they can be built-in with kitchen units.

As in the earlier models, each of the new boilers is available with a choice of flue offtake from the top or rear and both are, of course, fully automatic.

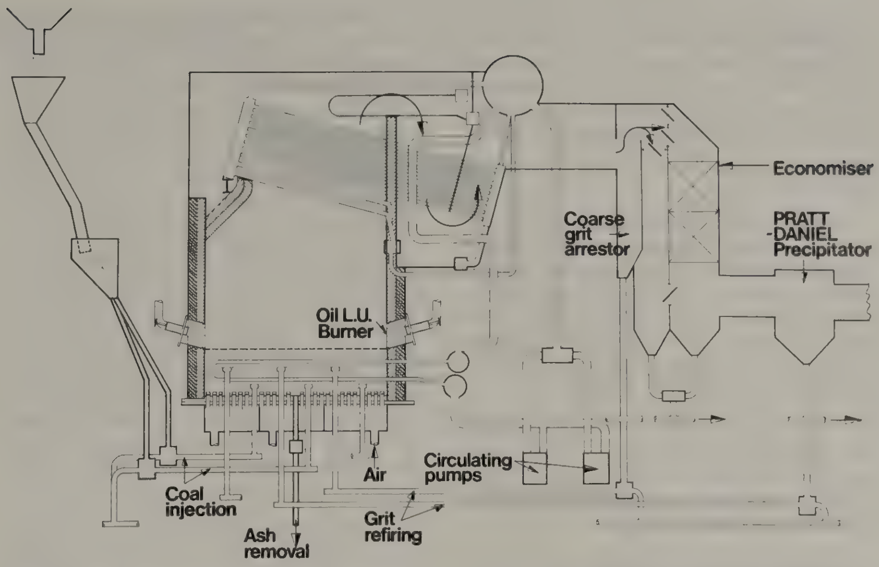
Reader Enquiry Service No. **7623**

Fluidised Bed Boiler at Renfrew

Work carried out in this country mainly by the National Coal Board has shown that fluidised bed combustion can handle low grade fuels of high ash content and that the addition of limestone to the fuel can fix the sulphur in the bed leading to substantial reduction in the emission of sulphur oxides in the stack gas. Work has also been undertaken by BP and NRDC.

Combustion Systems Limited was formed in 1974 by these three organisations to assemble this work as a unified package and investigate means of commercial exploitation.

Babcock & Wilcox Limited has now combined with CSL by forming a company called Babcock Combustion Systems Limited to enable major development contracts to be undertaken and to facilitate industrial applications of the process through B&W (Ops) Ltd, and Woodall-Duckham, both members of the Babcock Group.



The work undertaken by the members of CSL has involved over 20,000 hours of testing of various laboratory and pilot scale rigs, the largest being about 3ft sq. When B&W started to undertake studies for the design of large industrial and central power station boilers using this process it became evident that an intermediate size prototype plant was essential both to confirm the performance of the rigs on a larger scale and to investigate certain aspects, in particular, load following, which could not be studied at a small scale. Accordingly, in 1974, work was started on converting an existing coal fired boiler at the Renfrew works and this plant was commissioned in June last year. The questions that are now answered in the current test programme are:

1. What is the maximum pitching of fuel injection points that will give adequate interaction within the bed of fuel and air?
2. How much fine material would be elutriated from the bed, its combustible content, and the amount of refiring desirable or possible?
3. Do hot spots develop in the bed and can temperature variations occur around the tubes such as to promote excessive bending?
4. If tubes are pitched close together will they affect the fluidising action?
5. Are there erosion and/or corrosion problems in fluidised beds?
6. What are the separate and combined effects of bed temperature change, bed level change and partial bed slumping on load control, and response rate?
7. What development is needed in boiler start up, operation and shut down logic systems?
8. What is the NOx content of the flue gas and what quantity and sizing of limestone is required to limit the discharge of sulphur oxides to the required value?

The diagram shows the layout of the boiler which has a bed of 10′ × 10′.

Extensive fuel storage and handling systems are installed for coal, oil and natural gas. For coal firing the plant can operate on the bin and feeder system using dense phase transportation to the bed or direct firing from the coal mill using lighter phase. The advantage of the latter is simplicity, making coal separation equipment and storage air supply unnecessary, plus greater safety. For oil firing, oil storage and pumping and heating units installed will permit a wide range of fuel oils to be fired. Natural gas is available at about 2·5 psig which is ample for atmospheric operation.

The bed plate at present fitted is suitable for a fluidising velocity of about 4ft per sec resulting in steam generation of about 22,000lbs per hr at 450psi and 560°F; over half the evaporation taking place in the tubes submerged in the bed. The fans and pumps installed are suitable for twice this total output and in later tests the bed plate will be altered and additional heating surface installed in the bed to determine behaviour at higher outputs in order to establish optimum ratings for various applications.

The overall programme is intended to provide the Company with sufficient information to enable commercial offers to be made with guarantees for purpose designed fluidised bed boiler plant.

Reader Enquiry Service No. **7624**

BICC to Scrutinise Pollution Problems

British Insulated Callender's Cables Ltd is to set up a pollution and environmental control committee under the chairmanship of its medical officer, Dr H. Holden. Its main tasks will be to examine such problems as surface water contamination, water effluent, air-borne pollution and environmental hazards.

Dr Holden said today: "I hope the committee will increase co-ordination throughout the group on the subject of pollution and be a central collecting agency of more detailed knowledge about the environmental hazards produced in each of the group factories.

"While BICC regards itself as enjoying a good reputation in environmental matters, one cannot ignore that, in heavy industry, some interference with one's surroundings is almost unavoidable. This committee will be, I hope, a demonstration of our eternal vigilance in this area.

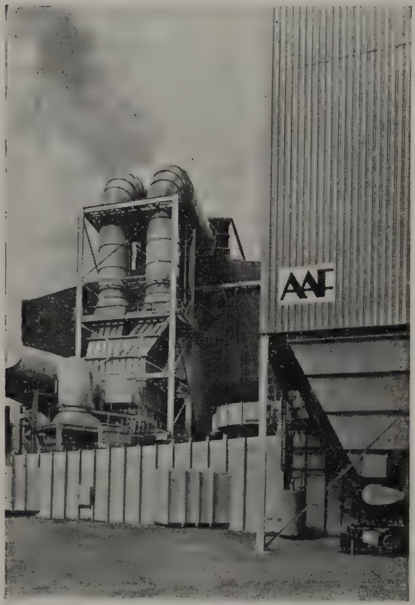
"This is a logical development of the pollution panel which functioned on our Prescot site some years ago and we will build on the experience gained from that".

In providing the expertise for consultation throughout the group factories, the committee will also advise on statutory requirements, on the analysis and recording appropriate to site processes, recommend on the use and sale of new processes as affected by the Health and Safety at Work Act, and co-operate on an industry basis with interested parties.

Reader Enquiry Service No. **7625**

AAF Emission Control System

AAF-Ltd recently completed installation of an air pollution control system costing approximately £1 million for the Tubes Division of British Steel Corporation.



AAF-Ltd supplied and installed an AAF AMERtherm fabric collector system to control emissions from two new 70-ton electric arc furnaces at British Steel Corporation's Clydesdale Works, Mossend, Scotland. The AAF system uses a combination of direct extraction and canopy hoods to collect and control emissions during charging, melting and pouring operations of the furnaces.

Gases are extracted directly from the furnaces by specially designed AAF water-cooled ductwork and routed to a combustion chamber where combustible emissions are ignited. Water-cooled, followed by unlined ducts then take the gases to the AAF AMERtherm fabric collector. AAF canopy hoods are mounted over the two furnaces to provide melt shop ventilation. Gases from the canopy hoods and furnace roofs are mixed prior to being cleaned by the AMERtherm fabric collector which has a gas handling capacity of nearly one million cubic feet per minute. Each furnace is designed to produce an approximate total of 30 tons of steel an hour. British Steel Corporation will use similar AAF air pollution control systems at various other works.

The business of AAF is the development, manufacture and sale of equipment and systems to improve and control the quality of environmental air. AAF's products and systems clean, move, cool, heat and control the temperature, humidity and noise level of the ambient air.

Reader Enquiry Service No. **7626**

Northern Ireland Firm Claim First in Plastics Recycling

Associated Polymers (NI) Limited of Newry, Northern Ireland have this week laid claim to a world 'first' at their revolutionary plastics recycling plant. Mr Ron Belch, General Manager of the plant, believes that his is the first integrated plant in the world accepting dirty plastic waste.

'We are able' Mr Belch explains, 'to take a fertiliser sack from the corner of a field, wash it, rinse it, dry it and generally reprocess it. What we are left with is usable granules ready to be shipped out'.

Fertiliser sacks, plastic film, pallet wrapping, carrier bags etc, now form a big part of the plant's input, coming from all parts of Northern Ireland and Britain. The Newry firm is happy about its ability to handle dirty plastics straight from the tiphead and produce clean materials for re-use.

Associated Polymers (NI) Ltd is currently negotiating with councils in Britain for supplies of plastics salvaged from domestic refuse. Clean granules will be shipped to processing plants through the recently modernised port of Warrenpoint.

Associated Polymers which at present employs 30 people, envisage an anual plastic waste turnover of 6,000 tons and a growth in the workforce to 70 when they extend their activities to cover the entire plastics range, including domestic and other industrial 'throw-aways' such as detergent bottles and even larged bulk containers. They will extend their processing operations to cater for polypropylene, nylon, and polystyrene waste in the near future.

Reader Enquiry Service No. **7627**

New Chairman for Nailsea

Nailsea Engineering Company Limited, of Blackburn, announce the appointment of Mr Herbert Robinson as Chairman and Commercial Adviser. Mr Robinson was Chairman of OCE-Skycopy Limited, until his resignation on 1st December, 1975, but still retains the position of Business Adviser and Marketing Consultant to that company.

Reader Enquiry Service No. **7628**

Peabody Scrubbers Clean Noxious Fumes from German Incinerators

When it is burnt, plastic gives off noxious fumes. This basic fact has led two West German cities to order pollution control equipment designed by Peabody Holmes Limited.

The governing bodies of Bremerhaven and Krefeld have ordered incineration systems to deal with the growing mountain of rubbish produced by the cities households and industry.

However, the growing volume of plastic in this causes a major headache —burning plastic produces dangerous fumes.

Under two contracts worth a total of £700,000, the two cities have ordered gas scrubbing systems designed by Peabody Holmes Limited.

These two systems—thought to be the first of their type in the world—each have a capacity of 100,000 cu.m per hour and will remove HCL and SO_2 from the exhaust gases.

Peabody Holmes have designed the systems and are supplying the internal components for the two systems to their West German licencee, Lugar of Herne near Dusseldorf.

Both scrubbing systems are based on the Peabody impingement plate, which consists of a perforated tray with an 'impingement' target set above each perforation. The toxic gases are sub-divided into many thousands of jets, which pass through the perforated plate and impinge on the target above at high velocities.

The high dust and fume removal efficiencies obtained from this impingement action are due to two main effects:

Direct impingement on the wetted target

Accelerated impact on liquor droplets and dust particles

The phenomenon of accelerated impact occurs as the gas stream tears liquor droplets from the surface of the scrubbing liquor, a proportion of the droplets being less than 100 micron size.

On leaving the impingement baffle the gases enter a blanket of liquid maintained over the tray and the resultant highly turbulent gas liquid interaction results in excellent heat/mass transfer rates from simultaneous gas absorption and dust removal.

Reader Enquiry Service No. **7629**

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Reader Enquiry Service No. **7630**

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Dust control equipment

PNU-JET
DUST CONTROL EQUIPMENT

BAG FILTERS – VENTURI SCRUBBERS – WET SUPPRESSION

EPEMA

NAILSEA ENGINEERING COMPANY LIMITED. THE GRANGE: EAST PARK ROAD. BLACKBURN BB1 8AT. TEL. BLACKBURN 63911. TELEX 63146.
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